



INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

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PROCEEDINGS
OF THE
FIRST
PAKISTAN SCIENCE CONFERENCE
LAHORE, 1949

PART I
OFFICIAL MATTERS
&
MISCELLANEOUS ADDRESSES



PUBLISHED BY
PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
LAHORE

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Standing 1st Row :—Khalil Ahmad, S. M. Abbas, Abdul Hamid, M. Zulfiqar, Mohd. Sharif, Agha Ahmad Husain, Hasan Ahmad.
2nd Row :—S. N. Naqvi, Mirza Anwar Beg, ———, S. Maqsood Ali, Ghulamullah, M. Anwar-ul-Haq, Abdul Hafiz, S. A. Momin, Mohd. Saeed, M. Aslam, M.A. Azeem, Mohd. Afzal, Imad-ud-Din, Agha Ghias-ud-Din, Sh. Abdul Hamid, Abdul Hamid, M. H. Khundkar, Tashkir Ahmad, Sultan Ahmad, N. A. Jiabaji, S. Warsi, M. Abdus Salam, M. Jamal Bhutta, Zia-ud-Din, ———, Abdul Hamid.
In chairs :—S. A. Hamid, M. Aslam, J. M. Benade, B. B. Qureshi, Hakim Ali, Riaz-i-Qadir, M. Afzal Husain, M. Qudrat-i Khuda, Nafis Ahmad, Bashir Ahmad, Abdus Sattar, H. K. Bhatti.
Front Row :—S. M. Yusuf, Majid Ahmad, Irshad Husain, M. Rizwan, ———, M Shuja Namus, Asrar Ahmad Qureshy, M. Sharif, G. M. K. Baloch, ———, R. H. Siddiqi, S.M.K Wasti, Lal Mohd. Chawla, ———, F. G. Ahmad, Karimullah, ———, S. A. Faseeh, Siraj-ud-Din, Zafar-ul-Islam.

PROCEEDINGS OF THE FIRST PAKISTAN SCIENCE CONFERENCE LAHORE 1949.

Part I—Official Matters & Miscellaneous Addresses

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INTRODUCTION

The First Pakistan Science Conference, of which the proceedings are presented in the following pages, will stand out as a landmark in the annals of scientific advancement in this newly born state. The conference was organized by the Pakistan Association for the Advancement of Science, and is intended to be an annual feature of its activities. The purpose of the Conference is to bring together leading scientists of the country and some from abroad, and to serve as a forum for the discussion of various important problems facing the country, which require an expert scientific approach for their solution.

The Pakistan Association for the Advancement of Science was founded in December, 1947, and this is the only association of its kind in Pakistan. Scientists from all over the country and from every field of science have extended their active co-operation to the building up of this association.

The main objects of the Association are :—

- (i) To promote science in all its branches.
- (ii) To provide an opportunity for mutual discussion and exchange of scientific knowledge among its members.
- (iii) To arrange for scientific publications.
- (iv) To organise public interest and public support for science.
- (v) To organise scientific conferences.
- (vi) To promote scientific research by the award of research fellowships.

The headquarters of the Association are located at the University Institute of Chemistry, Lahore. Two branches have been established at the Universities of Dacca and Karachi, in the Eastern and Western parts of Pakistan.

This first All-Pakistan Science Conference was held at Lahore under the auspices of the Panjab University from 9th to 13th April, 1949. The Conference was inaugurated by His Excellency Sir Francis Mudie, Chancellor of the Panjab University. After the inaugural session the Conference split up into six sections according to the programme. These sections continued their deliberations for three days. A total number of 204 scientific papers in all were presented to the Conference. In order to discuss the more important and urgent educational and scientific problems of this new state, the organising committee of the Conference had also arranged a number of symposia. A scientific and technical exhibition was also arranged during the Conference. In this exhibition a number of Government Departments, commercial firms and private Scientific Organisations took part. The exhibition remained open throughout the session of the Conference. The British Information Services arranged for the exhibition of a number of educational and scientific films some of which were specially flown out from England for this occasion,

Visits were arranged for the delegates to a number of places of scientific and historical interest. Occasions were provided to the delegates to meet and discuss problems of science informally at a number of receptions, lunches and dinners. For this provision of hospitality the Association is grateful to the Panjab University which gave a lunch to the delegates; Messrs. Batala Engineering Co., Lahore, and the Fazal-i-Omar Research Institute, Model Town, each of which organised a reception. A programme of variety entertainment was organised by Government College Amateur Dramatic Club. The Conference came to a close with a farewell banquet given by the Association in the University Hall.

ACKNOWLEDGEMENT

The President and Members of the Pakistan Association for the Advancement of Science wish to place on record their deep appreciation of the kind assistance extended to First Pakistan Science Conference in its work by the following :

All Donors and Members of the Reception committee.

The Central and Provincial Governments, the Governments of States, and other Organizations which nominated delegates and provided them facilities to attend the Conference.

The Presidents and Secretaries of the Sections, who worked at considerable pressure, and all authors who presented papers and participated in its deliberations at very short notice.

The authorities of the Panjab University and Government College, Lahore, who provided accomodation for the various Sections of the Conference.

All local members who acted as hosts to delegates from outside Lahore.

The Fazal-i-Omar Research Institute, and Messrs Batala Engineering Co., which arranged receptions, to meet the members of the Conference.

Dr. A. G. Asghar, Director of Land Reclamation who arranged visits and provided conveyance.

Mr. Anwar-ul-Haque who arranged the Exhibition.

The General President, Prof. M. Afzal Hussain, moved a resolution in the General Meeting which was unanimously adopted by all the Members of the Conference expressing their appreciation and indebtedness to the General Secretary Dr. Bashir Ahmad, the Joint Secretary Mr. Hasan Ahmad, Dr. G.M.K. Baloch and their colleagues for their work in the arrangements and organization of this Conference.

OFFICERS OF THE FIRST CONFERENCE

General President :

Professor M. Afzal Husain, M.A., M.Sc., Chairman, Pakistan Public Service Commission.

Vice-President :

Dr. S. M. Hosain, M.A., Ph.D., Vice-Chancellor, Dacca University.

Chairman, Reception Committee :

Dr. O. H. Malik, M.A., M.Sc., Ph.D., LL.D., Vice-Chancellor, Panjab University.

General Secretary :

Dr. Bashir Ahmad, M.Sc., Ph.D., F.R.I.C., F.N.I., Director, University Institute of Chemistry, Lahore.

Joint Secretary :

Mr. Hasan Ahmad, M. Sc., Public Analyst, Corporation of the City of Lahor.

PRESIDENTS & SECRETARIES OF SECTIONS

Agriculture and Forestry : Botany, Entomology.

President : Sir Roger Thomas, C.I.E., Agricultural Adviser to the Government of Sind, Karachi.

Secretary : Ch. Muhammad Afzal, B.Sc., A.I.C.T.A., Cotton Research Botanist, Department of Agriculture, Lyallpur.

Local Secretary : M. Hasan Ahmad, M.Sc., Public Analyst, Corporation of the City of Lahore.

Chemistry : Applied Chemistry, Metallurgy, Geology, Geography.

President : Dr. M. Qudrat-i-Khuda, D.Sc., Director of Public Instruction, East Bengal, Dacca.

Secretary : Dr. Mukarram Hussain Khundkar, Ph.D., Reader in Chemistry, Dacca University, Ramna, Dacca.

Local Secretary : Mr. S. Warsi, M.Sc., University Institute of Chemistry, Lahore.

Education : Sociology, Anthropology.

President : Dr. C. H. Rice, Ph.D., Principal, Forman Christian College, Lahore.

Secretary : Professor Q. M. Aslam, M.A., Professor of Psychology, Government College, Lahore.

Engineering : Irrigation, Hydel, Power, Hydraulics.

President : Mr. Hakim Ali, B.Sc. (Hons.), Principal, Engineering College, Dacca.

Secretary : Mr. A. R. Nisser, Elec. Engineer (Hons.), D. I. C., Professor of Electrical Engineering, Engineering College, Dacca.

Local Secretary : Mian Nazir Ahmad Jiabjee, B.Sc., P.S.E., Superintending Engineer, Public Health, Lahore.

Medicine : Veterinary Science, Zoology.

President : Colonel S. M. K. Mallick, M.B.E., M.B., B.S., D.P.H., Inspector-General, Civil Hospitals, Punjab, Lahore.

Secretary : Dr. G. M. K. Baloch, M.D., M.R.C.P., King Edward Medical College, Lahore.

Physics : Mathematics, Statistics, Astronomy, Meteorology.

President : Dr. Nazir Ahmad, M.Sc., Ph.D., F. Inst. P., Secretary, Development Board and Joint Secretary, Ministry of Economic Affairs, Karachi.

Secretary : Prof. S. A. Hamid, M.A., Professor of Mathematics, Government College, Lahore.

ASSOCIATE SECRETARIES

Reception and Accommodation : Dr. G. M. K. Baloch, M.D., M.R.C.P., King Edward Medical College, Lahore.

Finance and Treasurer : Dr. Badar-ud-Din, M.Sc., Ph.D., University Institute of Chemistry, Lahore.

Entertainment : Prof. S. A. Hamid, M.A., Professor of Mathematics, Government College, Lahore.

Programme : Mr. M. Afzal, M.A., Assistant Registrar, Panjab University.

Publicity : Mr. Abdul Qayyum, M.A., Head of the Department of Journalism, Panjab University.

Exhibition : Mr. Mohammad Anwarul Haque, M.Sc., Industrial Research Laboratory, Bank Road, Lahore.

RECEPTION COMMITTEE

Chairman :

Dr. O.H. Malik, Vice-Chancellor, Panjab University.

Members :

Dr. Abdul Ahad
Dr. S.S. Alam
F.R. M. Alvi Esqr.
Mohammad Anwarul Haque Esqr.
Professer M. Aslam
Ch. Muhammad Afzal
Col. M. Akram
Dr. Abdul Haque
Dr. Ameer-ud-Din
Lt. Col. Agha Ghais-ud-Din Ahmad
Dr. Abdul Ghaffar
Hasan Ahmad Esqr.
Dr. Shujaat Ali
M. Asadullah Esqr.
Dr. M. Abdul Ghani Bhutty
Dr. Hamid Khan Bhatti
Mohammad Karrar Beg Esqr.
Dr. Muhammad Fazil Butt
Dr. G.M.K. Baloch
Dr. Bashir Ahmad
Professor J.M. Benade
Dr. Muhammad Jamal Bhutta
Dr. Abdur Rashid Eirabie
Lt. Col. Elahi Bakhsh
Prof. S.A. Hamid
Kh. Mubashir Hasan
Dr. Siddiq Husain
Dilawar Husain Esqr.
Dr. Inayatullah
Ch. Abdul Rahim Khan

Malik Amanat Khan
Dr. Karimullah
K.A. Moin-ud-Din Khan
Lt. Comdr. Agha A. Latif
Dr. M. Abdul Qavi Luqman
C.M. Latif Esqr.
Lt. Col. S.M.K. Mallick
Col. Mahmud.
Dr. M.A. Pirzada
Dr. Ahmad Ali Qureshi
Shamim Husain Qadiri Esqr.
Dr. Riyaz-i-Qadeer
Dr. C.H. Rice
Dr. Ahmad Shah Nawaz
Dr. Muhammad Shafi
Dr. R.H. Siddiqui
H.G. Sadik Esquire
Dr. K.S. Shah
Prof. P.C. Speers
Lt. Col. M. Sarwar
Prof. M.A.A. Siddiqi
Lt. Col. M.H. Shah
G.R. Shauq Esqr.
Ahmad Hasan Taj Esqr.
Dr. S.M.K. Wasti
Dr. A. Rauf Yusuf
K.B., M. Yacob
Dr. Mohammad Yusuf
Col. M. Zia-ullah
M. Zaidi Esqr.

LIST OF DELEGATES

UNESCO

Prof. W. E. Purnell, Science Co-operation Office for Middle East,
UNESCO, Cairo, Egypt.

East Pakistan

Dr. M. Quadrat-i-Khuda,	Director of Public Instruction,	Govt. of East Bengal.
Mr. S. M. Ahmad,	Industrial Advisor,	" "
Mr. Hakim Ali,	Principal, Engineering College,	Dacca.
Mr. A. R. Niseer,	Engineering College,	"
Dr. M. H. Khundkar,	Reader in Chemistry,	Dacca University.
Dr. H. N. De,	Chemistry Deptt.,	" "
Dr. Majid Ahmad,	Reader in Botany,	" "
Mr. Nafis Ahmad,	Head of the Geography Deptt.,	" "

Azad Kashmir

Dr. Noor Husain, Director, Medical Services, Azad Kashmir Govt., Muzaffarabad.

Bahawalpur State

Dr. S. Zahir-ud-Din,	Veterinary & Live stock Officer,	Bahawalpur.
Dr. M. Shuja Namus,	Vice-Principal, S. E. College,	"

Karachi

Dr. Nazir Ahmad,	Secretary, Development Board,	Govt. of Pakistan.
Dr. M. I. D. Chughtai,	" "	"
Syed Mohammad Ilyas,	" "	"
M. Afzal,	" "	"
Dr. Ali Ahmad, Director, (Development) Ministry of Industries,		"
Dr. Ahmad Kamal,	" "	"
Dr. Taskhir Ahmad, Director of Plant Protection, Min. of Agri.,		"
Mr. Ghulam Ullah,	" "	"
Dr. Israrul Haq,	" "	"
Dr. S. M. K. Kheshgi,	" "	"
Mohammad Aslam, Director, Meteorological Service,		"
Dr. Mohammad Shabbar,	" "	"
Khan M. Shamshad,	" "	"
Dr. Siddique Husain, Deputy Director, Bureau of Laboratories,		"
Mr. K. J. Kabraji	Central Engineering Authority,	"
Mr. Altaf Qureshi,	Department of Civil Aviation,	"
Mr. Fazalur Rehman,	" "	"
S. M. F. Rehman,	Airway Training Centre,	"
M. U. A. Qureshi,	Karachi Airport,	"
Dr. Riaz Ahmad Khan,	Directorate of Medical Services.	"
Dr. (Mrs.) B. B. Qureshi,	Entomologist,	Karachi,
Dr. S. A. Faseeh;	D. J. S. Govt. Science College,	"
Syed Zahid Ali;	" "	"

Baluchistan

Dr. H. Crookshank,	Director, Geological Survey of Pakistan,	Quetta.
Dr. Riaz-ud-din Qureshi,	" "	"
Mr. M. Asghar Ginani,	Agriculture Department,	"
Mr. Nazeer Ahmad Janjua,	" "	"
Mr. Saeed Ahmad Malik,	" "	"
Agha Ahmad Husain,	Govt. College,	"

Sind

Sir Roger Thomas,	Agricultural Adviser,	Govt. of Sind.
Mr. Zafarul Islam,	Govt. College,	Hyderabad.

N.-W. F. P.

Dr. M. Abdussalam,	Pakistan Animal Husbandry Research Institute,	Peshawar.
Mr. G. Ahmad,	" "	"
Mr. Abdul Wahid,	" "	"
Mr. M. Sulyman Khan,	" "	"
Mirza Anwar Beg,	Chairman, Science Department, Islamia College,	"

Punjab

Col. M. H. Mahmud,	Consulting Surgeon,	G. H. Q. Rawalpindi.
Col. M. Akram,	Consulting Pathologist,	" "
Lt. Col. M. Sarwar,	Consulting Physician,	" "
Mr. G. Quamber,	Consulting Engineer,	Rawalpindi.
Dr. S. A. A. Anvery,	Director, Pakistan Forest College & Research Institute,	Murree.
Mr. S. M. Ishaq,	" "	" "
Mr. Abdul Hamid Khan,	" "	" "
Prof. Abdul Hamid,	Lawrence College,	Ghorah Gali.
Dr. Khan A. Rehman,	Principal, Pb. Agricultural College & Research Institute,	Lyallpur.
Dr. R. H. Siddiqui,	" "	" "
Ch. Sardar Mohammad,	" "	" "
Agha Giasuddin Ahmad,	" "	" "
Dr. Zafar Alam,	" "	" "
Ghulam Subhani Khan,	" "	" "
S. A. Makhdum,	" "	" "
S. L. Shah,	" "	" "
M. Latif,	" "	" "
S. M. Nawaz,	" "	" "
M. M. Sharif,	Govt. College,	" "
Syed Maqsood Ali,	Ghee Heating Centre, Okara,	Montgomery.
S. M. Hasnain Jaffri,	Govt. College,	" "
Mr. R. C. Thomas,	Murray College,	Sialkot.
Mr. F. Khair-ullah,	" "	" "
S. Liaqat Husain,	" "	" "
Mr. Faiz Ahmad Shams,	Emerson College,	Multan.

PROGRAMME OF THE SESSION

Saturday, April 9, 1949

10 to 11-4 ⁵ A.M.	Recitation from the Holy Quran.
" " "	Messages of Goodwill.
" " "	Welcome Address by the Chairman, Reception Committee.
" " "	Inauguration of the Conference by H.E. Sir Francis Mudie, K.C.S.I., K.C.I.E., O.B.E., Governor of Punjab.
" " "	Address by the General President.
" " "	Report of the Pakistan Association for the Advancement of Science by the General Secretary.
12 NOON	Visit to Exhibitions.
" " "	Visit to the Irrigation Research Institute and Medical Colleges.
2-30 to 5-0 P.M.	Reading of Papers in all Sections.
" " "	<i>Presidential Address</i> : Physics Section (2-30 p.m.)
" " "	<i>Pre-idential Address</i> : Chemistry Section (3-30 p.m.)
5-30 to 7-0 P.M.	Reception.
9-30 P.M.	Visit to Panjab University Observatory.

Sunday, April 10, 1949

Whole-day Excursions to places of scientific and historical interest.

Lahore

Railway Workshops
Punjab College of Engineering and Technology
Land Reclamation Laboratories
Shalamar Gardens
Jahangir's Tomb

Lyallpur

Punjab Agricultural College and Research Institute
Ganesh Mills

Chakanwali

Land Reclamation Experimental Farm.

5 P.M.

Public Lecture by Prof. P.T. Chandi, M.A., Head of the
Department of Mathematis, Forman Christian College
Lahore.

Subject : Birth of the Solar System.

7-30 P.M. Public Lecture by Lt. Col. Agha G. D. Ahmad, Professor of Botany, Agricultural College, Lyallpur.
Subject : Principles of plant improvements through plant breeding.

9-30 P.M. Visit to Panjab University Observatory.

Monday, April 11, 1949

9-15 to 10 A.M. *Presidential Address* : Section of Agriculture and Forestry.
 10 A.M. to 12-30 P.M. Symposium on 'Agriculture and Forest Wealth of Pakistan,'
 (Entire Conference) *Chairman* : Mian M. Afzal Husain
 12-30 P.M. Visit to Exhibitions
 Visit to the Irrigation Research Institute and Veterinary College
 2-30 to 5 P.M. Reading of Papers in all Sections
Presidential Address : Section of Engineering (2-30 p.m.)
Presidential Address : Section of Medicine (3-30 p.m.)
 7-30 P.M. Variety Entertainment

Tuesday, April 12, 1949

9-15 to 10 A.M. *Presidential Address* : Section of Education
 10 A.M. to 12-30 P.M. *Symposia on* :
 a. "Scientific Education.",
 b. "Water-Logging Problem in Pakistan"
 12-30 P.M. Visit to Scientific Institutions
 Reading of papers in all Sections.
 2-30 to 5-30 P.M. *Sections of Medicine and Chemistry* : Joint Symposium on
 'Nutrition in Relation to Health'.
Section of Education : Symposium on Teaching Illiterate Adults.
 Opening Speech by Dr. F. Laubach.
 9-30 P.M. Educational Films.

Wednesday, April 13, 1949

9 A.M. to 10-45 A.M. Symposium (Entire Conference) on :
 'Future of Industrial Development in Pakistan.'
Chairman : Dr. M. Qureshi M.Sc., Ph.D.. Director of Industries, West Punjab.
 10-45 A.M. to 12-30 P.M. Symposium (Entire Conference) on "Problem of a National Script"
Opening Speech by : Dr. M. D. Taseer.
 2-30 to 5-30 P.M. Inauguration of the Pakistan Association of Scientific Workers.
 General Meeting of the Pakistan Association for the Advancement of Science.
 Business Meetings of all Sections
 8 P.M. Banquet and Farewell to Delegates.

OPENING PROCEEDINGS

WELCOME SPEECH

By

DR. O. H. MALIK,

Vice-Chancellor, Panjab University, and Chairman of the Reception Committee.

YOUR EXCELLENCY, LADIES AND GENTLEMEN :

We have assembled here to assist at the inauguration of the First Session of the Pakistan Science Conference. This Conference has been sponsored by the Pakistan Association for the Advancement of Science, and I congratulate this Association on its enterprise in providing this opportunity to scientists to come together and to think out ways and means to promote the cause of science in this country.

Scientific Societies today play a very important role in the development and promotion of science. Realising this, we have tried to foster their growth in this University. In all its Science Departments, the University has encouraged the members of the staff and students to take active interest in Scientific Associations by organising meetings for the discussion of scientific subjects and for reading scientific papers, embodying original research. It is a matter of satisfaction to us that the Pakistan Association for the Advancement of Science took its birth in this University in 1947, and its centre is now located at the Panjab University Institute of Chemistry. As it should be, this Association was founded on an All Pakistan basis and within a month of its establishment scientists from all over Pakistan welcomed its birth by joining it as members.

During the 18 months of its existence, the Association has rapidly grown and expanded its activities. Two branches have been established in the two University centres in Lahore and Dacca. It is hoped that another will soon be actively functioning in the third University city of Karachi. The Association has started publishing the first scientific journal in Pakistan i.e., "The Pakistan Journal of Science." A part of this journal is devoted to publishing purely research papers. The Association has, during the past year, organised a number of important scientific meetings and lectures by eminent scientist, some of whom came from abroad. Now the Association has organised the First Pakistan Science Conference under the auspices of this University. By doing so the Pakistan Association for the Advancement of Science has satisfied a real need.

To this Conference have come scientists from all over Pakistan. There is a strong delegation of distinguished men from Dacca. We are grateful to them and welcome them. Their love of science has brought them from such a long distance. We have amongst us the official representatives of provinces and states, of the army and of scientific departments of the Central Government. To this Conference have

also come scientists and scientific workers from various scientific institutions, from the universities, and from every corner of the country. I welcome them all. I particularly welcome those leaders in science who have to guide the deliberations of the various sections of the Conference. They are: Mian M. Afzal Hussain, General President; Dr. Nazir Ahmad, Sir Roger Thomas, Dr. Quadrat-i-Khuda, Colonel S.M.K. Mallick, Principal Hakim Ali, and Dr. C. H. Rice.

I also welcome those eminent scientists, who have to preside at the various scientific symposia to be held during the Conference, and those who are to take part in them.

I welcome our guests and our visitors and all those who are assembled here this morning to witness the inauguration of the Conference. We are grateful to them all for their interest in science and for supporting its cause not only by their presence this morning but also by donations and by joining the Reception Committee of the Conference.

Before I request Your Excellency to inaugurate this conference, I cannot but mention that Scientific Associations of this type are sponsored and supported by the State and public bodies in all progressive countries. In Britain, the British Association for the Advancement of Science and the Royal Society, receive a substantial grant from the Treasury. In our neighbouring dominion, the National Institute of Sciences of India and Indian Science Congress receive a grant amounting to nearly three lacs of rupees from the Government of India. Unless the State and public organizations come to the help of this Scientific Association in Pakistan, it cannot go very far in achieving its objectives. It is essential that the scientific journals, which this Association publishes, or hopes to publish should be worthy of this country. It is essential that this premier organisation of scientists in Pakistan should take its due share in the development of science by the award of research fellowships to promising young workers. All this needs funds. I have, however, no doubt that the Central and Provincial Governments, and other public institutions will come to its aid.

Your Excellency, as a mathematician and a scientist, you would appreciate the value of such a Conference, and it is a matter of good luck for us in this University that we have an enlightened and sympathetic Patron of Science and learning like you at the helm of affairs in this province at a critical juncture in our history. We are deeply grateful to you for having found time in the midst of your multifarious engagements to come and inaugurate this Conference. We have no doubt, that under your fostering care this University will prosper, and this province will go forward from strength to strength in the field of science.

INAUGURAL SPEECH

By

HIS EXCELLENCY SIR FRANCIS MUDIE, K.C.S.I.,
Governor, Punjab.

MR. PRESIDENT, LADIES AND GENTLEMEN :

First of all it is my very pleasant duty to welcome to Lahore all those who have come here to attend the First Annual Conference of the Pakistan Association for the Advancement of Science. I am sure that they will find their visit instructive and we will all do our best to see that it is pleasant.

The formation of this Association is another proof—if further proof were needed—that those who held the view that Pakistan was an artificial creation of a few individuals to further their own ambitious ends, were entirely wrong. If that had been the case, would Pakistan have survived what it has survived, in particular the death of its great founder, the Quaid-i-Azam, and be to-day growing stronger instead of weaker in the tradition that he has left behind him? I do not mean strong in the military sense. I mean the kind of strength that is shown by a unanimity of public opinion regarding those matters that are essential for the safety of the State, by a feeling of confidence in the future and by the existence of all those corporate activities and interests which build up a nation. The formation of every such society as yours is a proof that Pakistan is not artificial, that it has a national life of its own, and that its people are confident in and are prepared to work for its advancement.

The objects of your Association are peculiarly important both because the search for truth, of which scientific research is a part, is one of the noblest activities of man and also because of the great work that applied science can do to increase wealth. Without the wealth that science brings, it is difficult to see how such things as compulsory primary education can be paid for or the leisure found for the highest cultural and scientific activities. Your activities are therefore two-sided, pure and applied science, and your Association has correspondingly two Journals. It is difficult to draw a hard and fast line between pure and applied science, but the approach is different. Applied science is generally directed. Pure science—research—must be free. But I doubt whether, however exalted the level, there has been any scientist—except possibly a few pure mathematicians,—who did not have at the back of his mind some practical problem which he thought that his labours might help to solve. On the other hand, if the direction of applied science is too detailed and close, the scientist loses initiative and resource. He ceases to be a scientist and degenerates into a mere technician. I can assure you that Government recognises the importance both of applied and of pure science. We will give our support to both, each in its different way. We will set you in greater or less detail the problems to which we want the answer, and we will also do what we can to encourage pure research, free from any interference.

Your Association is composed of scientists and is for scientists. What about the ordinary man? The importance of science is to-day universally recognised and,

inevitably, not only will greater facilities be given for the training of specialists, but the general education of the ordinary boy will be given a scientific bias. Fifty years ago the ordinary school boy who showed promise was generally discouraged from taking up science. Most of the academic prizes were reserved for those who specialised in the "humanities". The object then was to produce by means of a literary education what, without bothering about definitions, I may call an "educated man." And for a time it eminently succeeded. Later, as science came more and more to the fore this type of education became more and more divorced from life, and instead of being a broad liberal education it became a narrow one. It must still be our main object in education to produce broad-minded educated men with balanced minds. Only now we will have to do this through a curriculum that will have a scientific instead of a literary bias. We who advocate such a curriculum will be attacked on two grounds. Indeed there are two great dangers that we must avoid—narrowness and materialism. I see no reason why we should not avoid them. None of the great scientists was narrow-minded and few, if any, were materialists. The scientific mind is a broad one, restlessly inquiring into all aspects of reality that can be revealed by its methods, of which it realises the limitations.

We must not look on a scientific education merely as a means of producing certain results, however beneficial, or on the scientist as a mere employee of the administration or the business-man. Science is used in this way and scientists have in this way rendered great service to the world and will continue to do so. But to the pure scientist, the man who makes the great discoveries, these are side-shows. The scientist may have a particular aim in view, but in as far as he is a scientist and not a technician, his main object must be the acquisition of knowledge for its own sake. That and not the attainment of any material benefit is the urge that drives science and scientists forward.

If our approach is on these lines—if we look on science as an attempt in all humility to explore the great unknown—and we know so little—and if we realise that the scientific approach is only one of many, then a scientific curriculum cannot be either narrow or materialistic, and we need have no fear that, along with specialists, we cannot produce men educated in the best sense of the word, and mindful of the cultural tradition that they have inherited, and of those aspects of life with which science does not deal.

You have therefore a great work before you. Our need of scientists and technicians in all walks of life, in business and in Government service, is very great. We are a long way behind and the demand is increasing day by day. With your help and advice we set out to meet that demand with greater confidence. At the same time Government recognises the importance of pure research, which may at the time appear to be of little value, and we will do our best to encourage it and create an atmosphere in which it can flourish. I am sure that the Central and other Provincial Governments will do the same. We have at least made a start by giving you a grant of Rs. 25,000. I am sure that the Central and other Provincial Governments will follow suit.

Mr. President and Gentlemen, I wish this Conference and all future Conferences of your Association all success.

INTRODUCTORY REMARKS

By

BASHIR AHMAD, M.Sc., Ph.D., F.R.I.C., F.N.I.,

General Secretary, Pakistan Association for the Advancement of Science.

The Pakistan Association for the Advancement of Science was founded in 1947 soon after the establishment of Pakistan. It has the following objects :—

1. To promote science in all its branches.
2. To provide an opportunity for mutual discussion and exchange of scientific knowledge among its members.
3. To arrange for scientific publications.
4. To organize scientific conferences.
5. To organize public interest and public support for science.
6. To promote scientific research by the award of research fellowships.

Associations of this type exist in every country and play a very important role in the development of science and in the promotion of the material and economic progress of those countries. Their most important function is the co-ordination of scientific work. Pakistan is a new country and to build it up into a modern progressive State it is essential that both official and non-official scientists should work together under the auspices of an organization of this kind.

In Pakistan this is the only Scientific Association of its kind. During the last 18 months a large number of scientists from all over Pakistan have extended their active co-operation to the building up of the Association. Two branches are now actively functioning in the two University centres of Lahore and Dacca, and it is expected that a third one will soon be inaugurated at the seat of the third University in Pakistan, i.e., Karachi. The total number of membership is about 300 at the moment.

In addition to holding meetings for reading of scientific papers, informal discussions, symposia and lectures, the Association has three important items on its programme :

- (i) Publication of scientific journals. Two journals are already being published. The Medical Section of the Association desires to start another, *The Pakistan Journal of Medical Sciences*.
- (ii) The organization of an Annual Pakistan Science Conference. This morning the First Conference has been inaugurated.
- (iii) Creation of a number of research fellowships for the promotion of scientific research at various centres in Pakistan.

This last item is a recognized function of such Associations. In all progressive countries this is done out of public funds provided to the Association.

It has been estimated that to achieve these objectives, even to a very modest extent, a sum of Rs. 1,50,000/- is required annually. This sum the Association hopes to obtain in the following ways :

			Rs.
By membership subscriptions ; donations from enlightened individuals, public organizations, States and industrialists	...	...	50,000/-
Provincial Governments	...	...	50,000/-
Central Government	...	...	50,000/-
Total			1,50,000

We have no doubt, whatever, that this modest sum will be forthcoming. His Excellency has already made the announcement of a grant of Rs. 25,000/- on behalf of the Panjab Government. By doing so he has not only given the lead in this matter to other Provincial Governments and to the Central Government, but has shown the recognition and the trust which the Government has in this Association and its work. I am sure the Association will stand and live up to it, and will prove worthy of this trust. The message from the Prime Minister of Pakistan is very encouraging. I am sure the Government of Pakistan will also come to the help of the Association.

It is now my pleasant duty to thank His Excellency for inaugurating this Conference and to thank you all for having come to witness the ceremony. It is a guarantee of your interest in science and is a source of great encouragement to all members of this Conference. With your continued support the Association hopes to have a large spacious building of its own within the next five years to house its different activities, to have a large auditorium, and build the largest scientific and technical library in Pakistan. I thank you all once again. I shall now read the messages of goodwill received from His Excellency the Governor General and the Prime Minister of Pakistan.

Message from H. E. the Governor General

I have very great pleasure in sending my best wishes to the first session of the Pakistan Science Conference which is being convened at Lahore from the 9th April 1949, onwards. In this age of science and technology it is hardly necessary for me to dwell upon the great service which can be rendered by men of science to humanity in general and their own people in particular. I sincerely hope that the Conference will succeed in mobilizing scientific talent to the service of Pakistan and will inspire our young men to emulate noble examples of the great scientists of all times. I wish the Conference every success, and will watch the development of scientific movement in Pakistan with keen interest.

Message from the Prime Minister

I am very glad to be able to send this message to the Pakistan Science Conference which is to be held in Lahore from 9th April. In the world of to-day the material progress of a country depends almost entirely on science and technology. We all know what science has done for the world both in peace and war. No country can hope to survive if she ignores scientific research and development, as there is hardly any sphere of activity in which science does not play a dominant part to-day. The scientists working in Pakistan can rightly expect support from Government in their research and other activities. The Government will do all it can to encourage and help scientists in their work. I send my good wishes to the conference and hope that it will have a very successful session.

MISCELLANEOUS ADDRESSES

WATER-LOGGING AND THE SOILS OF WATER-LOGGED AREAS

By

A. G. ASGHAR, M.Sc., Ph.D.,

Director, Land Reclamation, Punjab, Pakistan.

The subject of water-logging is being discussed for the first time in a meeting of Scientists in a session of a Science Conference. When the proposal for such a discussion was considered in the Committee of the Conference it was desired that a number of scientists should take part in this symposium keeping in view the different aspects of the subject. I am, therefore, confining myself to a few of the research problems which have been dealt with regarding the subject.

It was in 1917 that the Provincial Government took notice of the menace of water-logging and a Drainage Board was constituted to investigate the causes and effects of water-logging and to propose suitable remedies. In 1925 the Drainage Board was split up into the "Water-logging Investigation Committee" and "Rural Sanitary Board."

There is no doubt that as early as 1892, Sir Thomas Higham proposed well observations in irrigated tracts of the Punjab with regular rainfall observations. These records now constitute a most valuable information although there are many inaccuracies as the method for taking such observations was neither standardized in the beginning nor any serious attempt was made afterwards.

There has been a steady rise in the sub-soil water level, and although the water-logged areas have not actually swelled in acreage, the fact that the sub-soil water level is coming nearer and nearer to the natural surface gives an indication, what may happen in the very near future. This menace being so dangerous, it is essential to take stock of our position and to chalk out a definite programme to get rid of it as early as possible.

Water-logged areas are defined on two basis :—

- (i) From the point of view of revenue assesment, a water-logged area is that, which due to the nearness of subsoil water-level, has deteriorated to such an extent, that it has become incapable of yielding even a four anna crop. This definition, though not scientific, is useful for granting *kharaba* remissions and also for carrying out *sem* and *thur girdawaris*.
- (ii) According to the scientific definition, a water-logged area is that in which the subsoil water-table has reached such a height, that it exists within a zone, where due to the capillary action, evapo-transpiration becomes operative, and any further rise of water-table decreases comparatively, as the additions of water due to which the subsoil water rises

are completely disposed of by the evapo-transpiration. When such conditions are reached, any further rise of sub-soil water level ceases and the land is termed as "Water-logged."

A general impression about water-logging is, that since the introduction of canal irrigation, there has been a constant as well as considerable rise in the level of the sub-soil water-table in the province. The causes of this rise had been under investigation for a number of years, and as a result, the following sources from which addition of water may possibly have been made to the water table have been examined :—

1. Rainfall.
2. Canal Irrigation System.
3. Increased intensity of cropping.
4. Flooding by rivers.

Statistical examination of the records made by Messrs Taylor, Malhotra and Mehta in 1936 showed that there was a significant co-relation between the rise of water-table and the monsoon rainfall.

The rise of water-table and the increase of irrigation were observed to be independent of one another and hence the former could not be considered as a result of the latter.

The insufficient data of pre-irrigation period, reproduced from the paper is given in Table I.

TABLE I
Showing the average rise of water-table for pre-irrigation years

<i>Year</i>	<i>Rise of water-table</i>	<i>Rainfall in inches</i>
1907-08	.85'	14.07"
1908-09	2.10'	33.10"
1909-10	.29'	23.59"
1910-11	1.25'	27.26"
1911-12	.80'	10.71"
1912-13	.75'	15.62"

The figures show that within a period of six years there was a rise of 2.74' in the sub-soil water level in the Upper Chenab Canal. There is no doubt that no regular scientific data is available to throw more light on the subject, still if the information given above is relied upon much importance cannot be attached to the conclusions already arrived at.

Only meagre attempts have been made to estimate the accretion of water to the sub-soil water-table due to irrigation system. There is no doubt that some work has been done but only on particular sites or reaches of various channels and the results cannot be taken for the entire canal system. In 1941-42 Blench attempted to estimate absorption losses from Lower Chenab Canal system and calculated, based partly on

examination of direct and indirect data and partly on personal assumptions, that there was an addition of 30% of the Head supply (8400 Cs.) of the Lower Chenab Canal, which is 2550 Cs. An important assumption made in this respect was that, as the total absorption is equal to the estimated addition to the water table, the canal system was considered responsible for the accretion to subsoil water. Detailed information regarding the addition of water from main line and its various branches is given in Table II.

TABLE II
Showing percent absorption losses from L.C.C. and its branches

		Blench	Kennedy
Main Canal	...	5	20
Branches	...	15	...
Distributaries	...	7	6
Water-courses	...	20	21
		<hr/>	<hr/>
Total	...	47	47

A similar calculation was made by Kennedy in 1917, in which although there was no difference in the total absorption losses, there was a little difference in the calculations for distributaries and water courses.

Besides rainfall and irrigation another factor may be responsible for rise of water table, and this is the spills from torrents, rivers and drains. For instance in the Rechna Doab AIK NALLAH overflows almost always. Similarly the river Jhelum is known to flood a large part of the country and as a result enormous quantity of water is added to the subsoil water in the Chaj Doab.

It has been observed that if the present canal irrigation system is lined the percolation losses would be reduced to a great extent and as a result the accretion to water table would decrease. The prohibitive cost is the main difficulty, but apart from this there is the important time factor which stands in the way.

No significant amount of work has been carried out to examine the effect of increased irrigation intensity on the rise of water-table. However, there is a possibility of controlling any addition to the subsoil water by adopting a suitable crop rotation and economical use of canal or well irrigation water. The major crops of the province are sugarcane, rice, wheat and cotton; the former two require high delta and latter ones low delta of water. If a field is kept fallow during *kharif* and *rabi* season there are appreciable losses due to evaporation of moisture from the soil surface.

Lysimeter experiments were started in 1946, and although the work has been continuously going on, still, definite results cannot be put forth during such a short time. However, it has been observed that rice could be matured by using 43.0" of irrigation in addition to 14.0" of rain during *kharif* 1946. Out of total irrigation of 57.0", the sub-soil water received 13.98". Thus 24.5% of surface application reached the water-table.

In the case of sugarcane, the total irrigation used was 51.0" in addition to 7.74" of rain during the year 1947-48. Out of total surface application of 58.74", the accretion to the water-table was 4.9".

Cotton was matured by using 20.5" of irrigation in addition to 14.01" of rain. In this case 4.0" of water was added to the water-table to keep it at a constant level, showing thereby that during cotton cultivation this much water was lost by evaporation and transpiration.

During 1947 the observations made regarding maize, showed that the crop was matured by using 15.0" of irrigation in addition to 3.69" of rainfall. In this case 0.73" of water had to be added to the sub-soil water table in order to keep it at a constant level.

Observations made in the case of wheat and gram were also of the same order, and showed that both these *rabi* crops did not make any accretion to the water-table, on the other hand the water-table was lowered showing thereby a loss of moisture.

It is clear from the above that if any accretion is possible to the subsoil water it can only be done during rice or sugarcane cultivation.

*Figs. 1 & 1A show the increase in the cropping intensity of sugarcane, cotton, maize and rice in the two Doabs, Chaj and Rechna, for the years 1929 to 1947.

There is not much increase in the cropping intensity during the last few years, and, therefore, no addition can be expected due to it. However, if some accretion is possible the other crops which require small deltas of water would have produced a lowering in the water-table to the same extent as the increase is expected by other crops. It is, therefore, quite reasonable to conclude that the water-table has not been raised due to the increased intensity of cropping. The results should not be considered as conclusive and further observations would be necessary.

It will be of interest if the process of rise of subsoil water level is explained. A typical soil profile of this province consists of a soil crust of varying thickness generally containing 15 to 20% of clay, and underneath the soil crust, with sharp line of demarcation, is coarse silt and sand which is almost devoid of clay. The moisture distribution in such a soil profile is shown for the sake of illustration in Fig. 2. It would be seen that starting from the natural surface there is a steep gradient of moisture content due to evaporation and transpiration. A zone of higher but more or less constant moisture content follows the zone of moisture gradient up to a certain depth. The third zone which is of still a higher moisture content follows the zone of constant moisture content and extends up to the subsoil water. According to Taylor these three zones have been termed as Pellicular Zone, Field Capacity Zone and Capillary Zone respectively.

Thus it would be clear that if any addition is made to the water-table, it may be due to rainfall, seepage from irrigation system or increased intensity of cropping and the consequent increase in irrigation intensity, the subsoil water level would start rising in the sand strata till it reaches a height where it is likely to be influenced by two factors, namely, surface evaporation and the soil crust which is different in its physical as well as chemical characteristics from the sand stratum which the subsoil water table has already traversed.

* All Figs. are given at the end of the article.

The first being a controvertial subject, not directly connected with the present symposium, is not dealt with here. However, a few words regarding the second factor would not be out of place.

It is well known that soil particles are colloids in character and show the property of swelling when they come into contact with water. Further, the mass of soil particles adhering together in the form of lumps are disintergrated into their component particles and the process is called dispersion. Naturally this dispersion, combined with swelling property of soil colloids, would help to fill up the pore space of the soil profile and as a result the rate of percolation of water would decrease and, therefore, one would expect a decrease in the rise of subsoil water level. Thus it may be expected that although the rate of rise of sub-soil water level within the sandy stratum be regularly constant, it may decrease when the water has to rise through soil crust.

From the definition of 'Water-logging' viz., "the water-logged area is that in which the subsoil water level has reached such a height that it comes within the zone from where the water is lost by evaporation and in which further rise has stopped", it appears as if water-logging is independent of any soil factor under all conditions. This conclusion is erroneous as would be clear from the following two experiments.

An experiment was carried out with the object of watching the rise of water table in a soil column, by means of an iron tube of 4" diameter. The details of this experiment are shown in Fig. 3, where AB is the iron tube 10 feet long with the side tubes T₁, T₂, T₃..... at respective distances of 1', 2', 3'.....from the bottom of the tube. Coarse *bajri* was filled in up to a height of 1 foot from the bottom of the tube and over it soil containing 15% of clay and .01% salts was compacted up to the top at 12% moisture by means of a rod.

Water-table was maintained at a height of 8 feet from the bottom of the iron tube by means of a burette filled with water which served as a water head and supplied water to the bottom of iron tube through rubber tubing. The rise of the water table within the main tube was observed by the appearance of water in the side tubes. The following Table III shows the rise of water-table in the soil column :—

TABLE III
Showing the rise of water-table in the soil column

Rise of water-table in feet from the bottom			Time
.5'	...	...	5 days
1.5'	...	...	4 months and one day.
2.5'	...	...	9 months and 6 days.
3.5'	...	...	9 months and 13 days.
4.5'	...	...	2 years, 8 months and 28 days.
5.5'	...	...	No water.
6.5'	...	...	...
7.5'	...	...
8.5'	...	...
9.5'	...	...

It is evident that the water pierced through the soil column of 4.5 feet in two years and 8 months. The gradual decrease in the rate of rise of water indicates the possibility that at some later stage the rise may become negligible or may altogether cease.

In the early stages of the experiment a large amount of water was absorbed by the soil, but gradually the absorption decreased. The loss of water can be explained due to the surface evaporation at the upper end of the experimental tube. For the verification of this fact experimentally, another iron tube was set up. The upper end of this tube was enclosed in and soldered to another tube of bigger diameter so as to make a double-walled end. The space between the inner tube and the outer tube was filled with water. This provided a saturated vapour space at the open end of the tube, and helped to reduce the rate of evaporation from the soil surface. Observations regarding the amount of water being absorbed by the soil column were taken which were indential to the results mentioned above.

One can visualize an interesting state of affairs in soil profile which does not show a uniform distribution of clay. The soil crust in the province varies from place to place and, therefore, one may expect different heights of the subsoil water. Further the subsoil water can also be expected to be under pressure below a thick soil crust.

Since the nature of the soil is an important factor in determining its permeability to water, a definition of the soil crust that can prevent the rise of water-table seems called for. Obviously such an attempt is beset with difficulties because there are more than one factors involved. However, it can be stated, with a fair amount of justification, that soil crust containing at least 15% clay and having pH value not less than 8.5 and a salt content not more than .5%, will prevent further rise of water-table when touching it. Such a soil crust when present to a depth of at least 10' will ensure that the area will not become water-logged in consequence of a rising water-table. As a result of examination of more than 100 profiles from different areas no case was met with of an exception to this rule. Obviously this rule cannot have any application to the low-lying areas where flood water would collect and produce a state of water-logging. It is only applicable to areas where water-logging is produced by rise of subsoil water level. The limitation introduced by an excessive amount of salts is due to the enhanced permeability of the soil, which behaves as if it contains a small amount of clay in the presence of salts. High alkalinity and clay content on the other hand, by reducing permeability decreased still further the minimum depth of soil crust required for checking the rise of water-table.

The mechanism of moisture distribution in a soil profile touching the water-table is largely the result of a dynamic equilibrium between two opposing forces, namely, the absorption and rise of water by capillarity and its loss by evaporation at the surface. In earlier days the generally accepted view regarding the maximum height to which water can rise by capillarity was that it cannot rise more than 6 feet even in the heaviest clays and this rate of rise is limited by the permeability of the soil. If the soil crust was about 6 feet in thickness and the rate of evaporation less than the rate of capillary rise, the soil will have a more or less uniform moisture content throughout the profile down to the water-table. If on the other hand, the rate of evaporation is greater than the rate of capillary rise, the top portion will become

dry and there will be a steep moisture gradient up to a certain depth from the surface. This region of steep moisture gradient may extend to a few inches only when the soil crust is only 6 feet. When the soil crust is more than 6 feet, the portion above the limit to which the capillary may extend has a steep moisture gradient, and the portion within the capillary zone has a uniform moisture content.

Estimation of the moisture content of the soil profile, therefore, offers very valuable information regarding the possibilities of water logging in an area where the water-table is touching the soil crust.

A very interesting observation was made in 1940. The clay crust at R. D. 1,80,000 at a point 300 feet away from the Main Line, Lower Chenab Canal, is 13 feet in thickness. The following Table IV, shows the moisture and clay distribution in this profile.

TABLE IV.

Showing the moisture and clay content at every foot down to the water-table at R.D. 1,80,000 Lower Chenab Canal.

Depth	Moisture %	Clay %	
0—1'	4.8	16.3	
1—2'	6.1	13.8	
2—3'	10.1	27.7	
3—4'	13.9	19.4	
4—5'	20.2	22.1	
5—6'	23.3	24.6	Water rose to 6'-1" on piercing the soil crust.
6—7'	23.1	24.5	
7—8'	23.3	18.2	
8—9'	22.9	19.2	
9—10'	24.5	26.6	
10—11'	26.5	17.2	
11—12'	26.4	21.3	Water-table situated at this depth.
12—13'	25.7	24.4	
13—14'	34.5	7.1	

It will be seen that the soil crust at this place is 13 feet. The sudden drop in clay content from 24.4 to 7.1 per cent is typical of the line of demarcation between the soil crust and the sand stratum underneath. There is generally some mixing of the soil and sand at this junction but the difference in texture is striking and cannot be mistaken. The sudden increase in moisture content in the sand stratum is also characteristic of these profiles. For instance, in this particular case, the sample at the 13th foot contained 25.7% moisture which was just about equal to the field moisture. The sample from the 14th foot, on the other hand, was wet and water could be squeezed out of it by pressing it in the hand. This condition is so characteristic that there is no difficulty in locating the water-table without having to determine the moisture content.

When the soil crust was pierced by the sampler, the water-table immediately rose in the bore hole with such a force that 3'—2" of sand was also blown into it. The following Table V shows the rate of rise of water-table in the bore hole,

TABLE V
Showing the rate of rise of water-table in the bore hole

Time after piercing the soil crust	Depth of water in the bore from natural surface
1 Minute	9'-8"
5 Minutes	8'-1"
10 "	7'-0"
15 "	6'-9"
20 "	6'-7"
25 "	6'-6"
30 "	6'-5"
40 "	6'-4"
50 "	6'-3"
5 Hours	6'-1"

It is a remarkable phenomenon that the water-table actually rose by about 7 feet when the soil crust was pierced. In other words, the subsoil water was exerting an upward pressure of this magnitude and yet could not pierce the soil crust. It might be argued that the water-table was actually at the 6th foot in the soil layer. This is hardly likely for the following reasons :—

(a) The moisture content of the soil below 6th foot is lower than the saturation point. Samples from the 10th to the 13th foot were examined for their field moisture capacity without drying. It was found that except the sample from the 13th foot which was actually touching the water-table, they were all below their field capacity by 1 to 4 per cent showing that there could not have been any free water.

(b) If the water-table had been actually at the 6th foot the soil above it would have shown a higher moisture content than what was actually found. This will be clear from the following Table VI which gives the clay and moisture percentage in a soil profile taken on the same day at R.D. 1,75,000 Lower Chenab Canal i.e., only a mile away from the profile described before.

TABLE VI
Showing the clay and moisture percentage at R. D. 1,75,000

Depth	Moisture %	Clay %
0-1'	12.9	19.2
1-2'	18.3	22.6
2-3'	20.8	16.6
3-4'	23.6	17.7
4-5'	25.9	13.4
5-6'	30.3	14.2
6-7'	34.3	11.8
7-8'	31.8	8.7
8-9'	29.0	6.1

Water-table.

The soil crust at this place is only 6.7 feet in thickness, the line of demarcation between the soil and the sand was not very sharp and there was no rise in the water-table when the soil crust was pierced. The moisture content of the soil right up to the surface is high. The rate of evaporation of moisture at R.D. 1,80,000 cannot be much higher than at R.D. 1,75,000. The steeper moisture gradient at R.D. 1,80,000 cannot be explained on any other assumption than that the water-table was actually not at the 6th foot.

It has been shown that the moisture content of the soil even at the 12th foot was slightly below the field-moisture capacity. This condition is determined by kneading the soil with water until a drop of water placed on it is not absorbed and remains on the surface as free water. At this moisture content, the soil still has a considerable suction force and is by no means in a saturated state (Schofield). This fact could not be reconciled with the supposition that the water-table was actually in this portion, unless a different meaning is assigned to the water-table than that generally understood. If it is conceded that a moisture content of 23—24 per cent in a soil containing 27—24 per cent clay corresponds to a condition in which the water-table is actually situated in it, then water-logging would lose some of its worst features because at this moisture content in the soils, it would be possible to raise crops without difficulty, since this would be the optimum moisture condition for plant growth.

It would thus be seen that the rise in free level of sub-soil water-table is also controlled by some soil factors. This view is further supported by systematic well records, a few instances of which are given in Fig. 4, showing a regular increase every year till the sub-soil water just touches the soil crust. Under these conditions the regular rise is stopped and the curve flattens out as if being kept depressed by the soil crust.

It would be seen that there is every possibility of attaining a condition in which, although the sub-soil water level is not within the definition of water-logging, any further rise is stopped due to physical characteristic of profile. It is, therefore, obvious that the present definition of water-logging is not very comprehensive as it does not include all the variable characteristics of the soils of the Punjab.

The province of Punjab may be divided into a number of separate units within the various river boundries. The extent of area having varying water-table for the two Doabs, Rechna and Chaj, is given in Table VII.

TABLE VII
Showing varying water-table in different Doabs.

Name of Doabs		Depth of Water-table	Area in acres
Rechna	...	0—5'	1,84,320
	...	5—10'	20,48,000
	...	10—15'	22,42,560
Chaj	...	0—5'	2,91,841
	...	5—10'	14,69,440
	...	10—15'	9,19,040

It will be seen that, for the present, although the area under danger of water-logging is not of a very high order yet the rate of rise of watertable is high and the problem is more serious than it appears to be.

Soils of Water-logged Area.

The soils of the Punjab differ from typical soils of other regions in some important features. These soils consist of an alluvial deposit resting over coarse sand strata. The general chemical characteristic of these soils is that they contain sodium salts and are alkaline. A typical alkaline soil consists of a laminated superficial horizon overlying a deep layer showing a columnar or prismatic structure. The rounded tops of the columnar elements and the vertical sides frequently carry a white deposit of salts. The soil colours are grey or greyish brown throughout. A number of such profiles have been described by Robinson and Joffe.

From the above classification it would be evident that although the description may be useful for explaining the genesis of the type, it serves little purpose as a practical guide, because it is not possible to take large number of soil samples during soil survey. It is, therefore, necessary that a classification based on some physico-chemical examination of the soils in the laboratory be adopted.

The Punjab soils being alluvial, containing variable concentrations of different salts and existing in arid climate with water-table between 0.0 to 100' from the natural surface, the fundamental physico-chemical properties are different in different tracts and can, therefore, be studied for classification purposes.

An alkaline soil profile is found to exist in three well marked layers (1) an upper highly alkaline layer, compact and impervious, (2) a layer of medium alkalinity containing calcium carbonate nodule (*kankar*), (3) a layer with lower alkalinity and higher permeability than 1 and 2. These three layers are usually found to be resting on sand strata.

A number of such profiles were studied by Puri, Taylor and Asghar and as a result it was observed that the alkalinity decreases from the surface downwards and there is generally a sharp break in the *kankar* layer, the soil underneath the *kankar* layer has a lower alkalinity and clay content than the layers above. Exchangeable calcium varies in the opposite direction, it is generally low in the surface layer and increases with depth. The formation of *kankar* in such profiles can be explained by the hypothesis that underground water dissolves calcium carbonate in presence of carbon dioxide, and under rising water-table when it comes into contact with alkaline sodium clay it deposits calcium carbonate in the form of nodules. The exchangeable sodium in the clay complex is replaced by calcium and the sodium carbonate thus set free moves towards the natural surface. The alkalinity of the upper layer of the soil is increased. If the water-table lowers under certain conditions and has the tendency to rise again, this action is repeated, resulting in the formation of bigger lumps of *kankar*.

The description given above naturally shows that the *kankar* formation takes place from lower depths towards the surface.

It would thus be seen that when dealing with water-logged areas one, has to manage soil profile of absolutely a different nature from a typical soil profile of the province.

Management of Soils of water-logged areas.

An important problem in this province was, therefore, of devising methods of reclamation of waterlogged areas. The first attempt was made at Chakanwali and the matter was discussed in the Drainage Board somewhere in 1917. As waterlogging brought about radical changes in the soil texture and soil characteristics, making the land unfit for cultivation purposes, it was decided that an experimental station should be started to investigate the causes of infertility of water-logged areas, the permanent changes in the chemical and mechanical composition of soils, and the methods by which these could be restored to normal fertility.

The Chakanwali Experimental Farm comprises an area of approximately 3645 acres and consists of 3 villages. Some idea of the condition of the land when it was acquired for experiments can be obtained from Fig. 5. In the area shown as salt land and sem there was water standing all over and except for a short dry period the travellers had to wade through water. There were large ponds distributed all over the Estate. Area shown as cultured was only under cultivation and on this practically nothing but rice was grown.

The experimental work comprised of investigations on:—

- (a) Drainage and lowering of water-table.
- (b) Crop rotations suitable for Chakanwali conditions.
- (c) Reclamation of *Thur* and *Rakkar* area.

(a) Drainage and Lowering of watertable.

Several methods for providing drainage and the lowering water-table were tried. Different types of drains were constructed.

(i) Open drains.

The Kalerwala drain provided the outfall for all the subsidiary drains. The land was divided into blocks of 1500' X 1500' as this size is convenient for working with steam tackle. The field drains were dug with the help of ditching implements and were placed perpendicular to the canal separated by a distance of 110'. The subsidiary drains were provided on all the sides of the block. In the year 1930, the direction of the field drains was changed and instead of making them perpendicular to the canal, they were made parallel. The field, subsidiary and collector drains were silt cleared and kept free from weeds by manual labour.

(ii) Mole drains.

It was estimated that approximately 10% of land is taken up by field and collector drains. To overcome this difficulty two types of drains were tried. The mole drains were constructed by the help of a machine. Unfortunately it was found that although there was a good discharge for a few hours the drain collapsed after a short interval. The lining of mole with earthen-ware tiles did not improve the conditions. However, with very great efforts one of the plots was provided with this type of drainage.

(iii) Sunken drains.

The second type was the Sunken drain which was evolved as a result of experiments in 1926 from porous concrete materials. The porous concrete pipes were manufactured at Abbots Factory, Jhansi. With the help of excavator 1600' gallery of porous pipe was laid with manholes at every 200' distance. In these manholes

provision was made for smaller diameter porous pipes from the sides to empty themselves. This gallery was tested and was found to be capable of giving a discharge of approximately 1 Cs. continuously. The prohibitive cost of the porous pipes stood in the way and further development was discouraging.

(b) **Crop rotation suitable for Chakanwali conditions.**

Different rotations of crops were introduced in the area which was provided with drains and it was found that if the drainage system worked efficiently and water was not allowed to stagnate in drains, almost all crops were successful and gave good returns. Of all the crops, sugarcane was found to be the hardiest so far as the water-logging was concerned. Cotton was more sensitive and maize still more so. The general agricultural operations were only slightly altered to suit high watertable conditions.

To start with, when the Chakanwali was taken up under reclamation the soil could be classified as below :—

Waterlogged land (<i>sem</i>).	...	...	700 Acres.
<i>Thur</i> and <i>Rakkar</i>.	...	...	2260 „
Culturable, mostly fit for rice only	...	...	685 „
Total			3645 Acres

The present condition of the area can be gauged from the classification given below :—

Area under cultivation.	...	...	1893.60 Acres.
Area occupied by road & drains.	...	...	415.48 „
Area under canals and <i>abaais</i>.	...	...	103.05 „
Area still requiring levelling.	...	...	243.10 „
<i>Thur</i> and <i>Rakkar</i> still to be reclaimed	...	...	988.83 „
Total			3644.67 Acres.

To give an idea of the various crops grown at the Farm the particulars are given below for the year 1947 :—

Kharif Crops				Rabi Crops			
Rice	...	...	1481.61 Acres	Wheat	...	...	344.91 Acres.
Sugarcane	...	...	26.00 „	Wheat-gram	...	...	307.31 „
Cotton	...	...	70.75 „	Grams	...	...	6.71 „
Kharif fodder	...	...	56.85 „	Barley	...	...	59.43 „
<i>Jantar</i>	...	...	62.70 „	Lentil	...	...	3.88 „
<i>San</i>	...	...	44.84 „	Rabi Fodder	...	...	96.72 „
Tobacco	...	...	7.98 „	Garden	...	...	10.00 „
Garden & vegetables	...	...	10.10 „	Barley-gram	...	...	9.34 „
Maize	...	...	26.00 „	Total			934.76 Acres
<i>Arhar</i>	...	...	2.19 „				
<i>Guara</i>	...	...	17.08 „				
Total			1806.10 Acres				

A vegetable-cum-fruit garden was started in the year 1944 in 10 acres, but has now been extended to 36 acres. Trials with oranges and *sangtras* have proved a failure. Plants of guavas, *falsas*, pomegranates, pears and peaches have established well and are bearing fruit.

Plants of *kikar*, *shisham*, willow and poplar have been established with the aim to produce wood at the farm for fuel and implements. The willow wood finds many uses. It can be used for agricultural implements like *panjalis*, and in the manufacture of sports goods, etc., etc.

It would thus be seen that although the problem of water-logging is a serious one and as a result some very important changes are brought about in the soil profile, the attempts of the province to reduce water-logging as well as reclaiming the areas affected by this menace have been appreciably successful.

At the end, I may mention that a very great difficulty is being felt due to the shortages of qualified staff for Soil-Management and Soil Research. The only Institution in this Province, I may be allowed to say in the whole of Pakistan, is the Punjab Agricultural College, Lyallpur. The college has greater interest in the academic side of producing Graduates in Agriculture. This I would call basic education for Scientists who would like to enter into suitable Departments for higher Research work on Soil. Unfortunately there are no facilities for Soil Research and it is, therefore, necessary that the government should consider seriously to provide facilities of training to our young men in Soil Chemistry as well as Agricultural Chemistry. Further, it would not be out of place if I may make a suggestion for a separate chair of Soil Chemistry in the University of the Panjab.

I am thankful to Mr. H. S. Zaidi, Assistant Research Officer, who has helped me a great deal in getting various references, and in the preparation of diagrams etc., for this symposium.

FIG. I.—SHOWING THE CROPPING INTENSITY IN
RACHNA DOAB

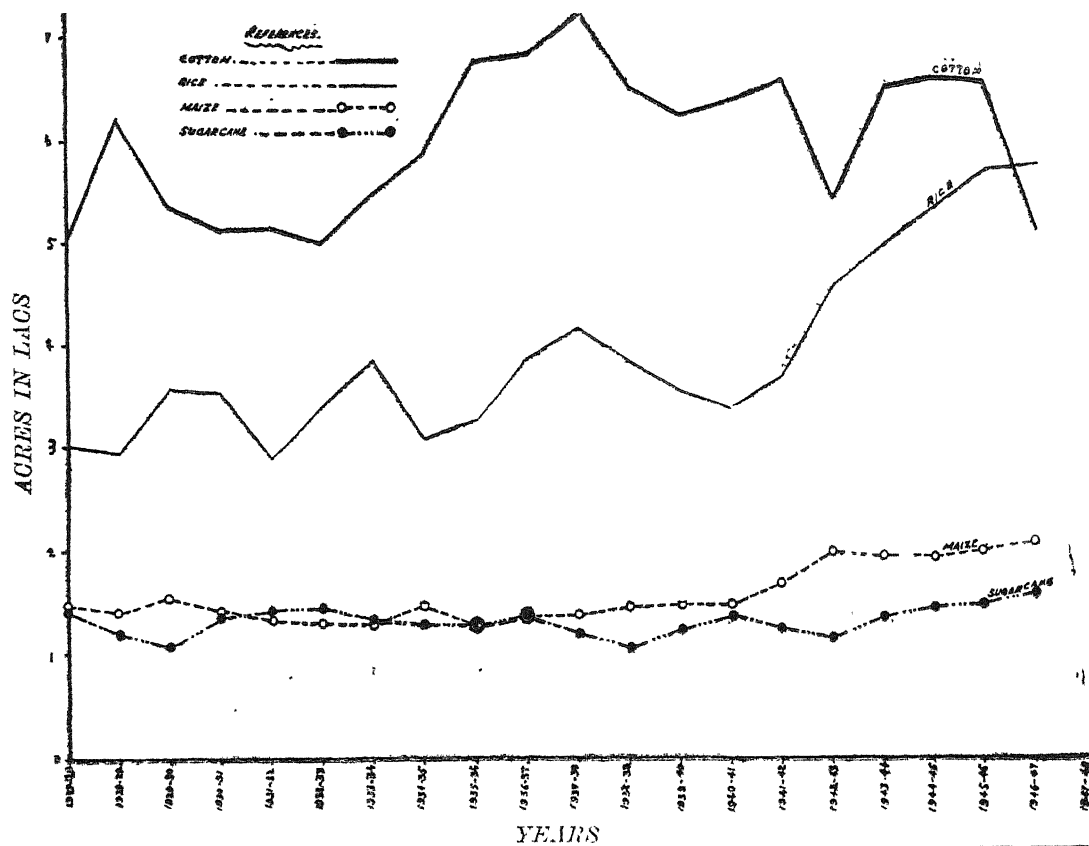


FIG. I (A).—SHOWING THE CROPPING INTENSITY
IN CHAJ DOAB

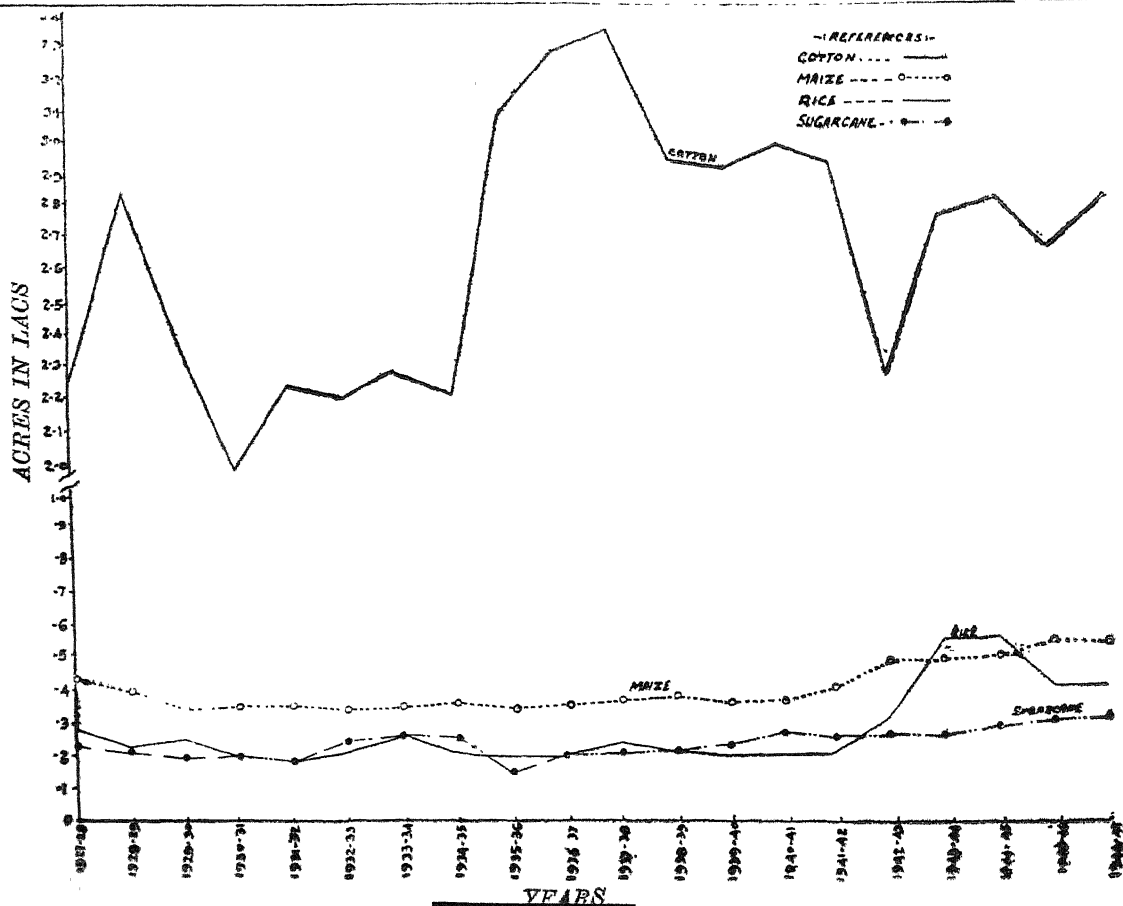


Fig. 2.
SHOWING MOISTURE DISTRIBUTION
IN A TYPICAL SOIL PROFILE

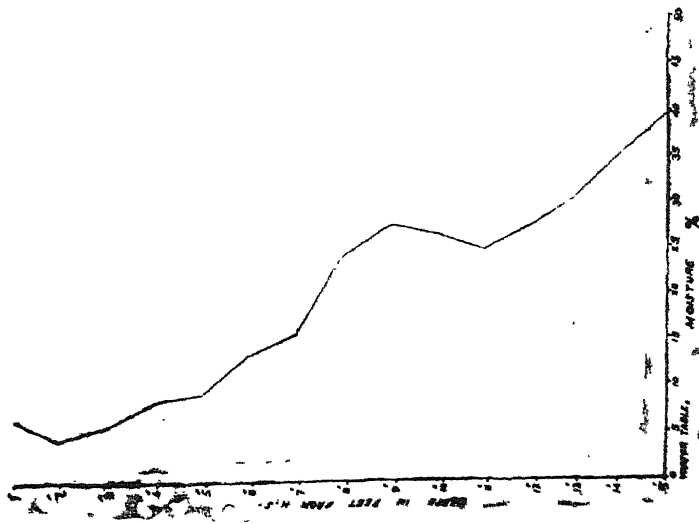


Fig. 3.
IRON TUBE CONTAINING SOIL

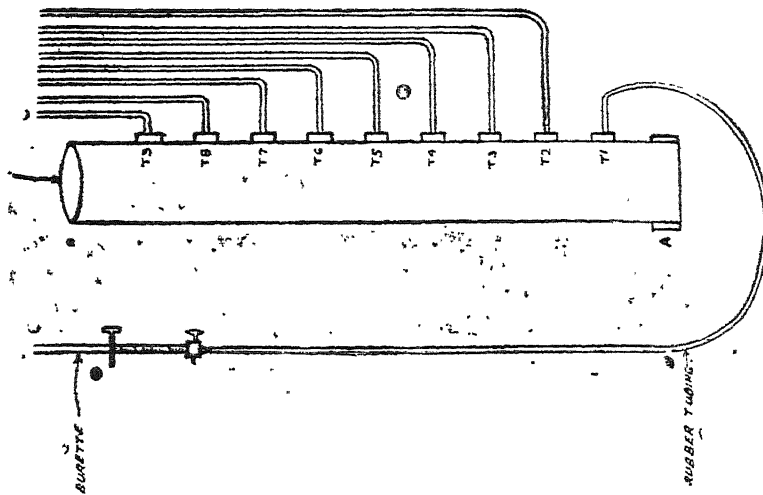


Fig. 4.
RATE OF RISE OF WATER-TABLE

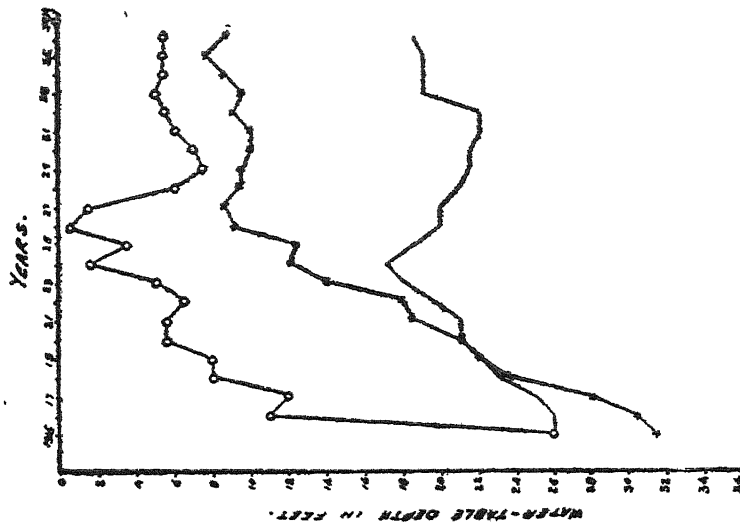
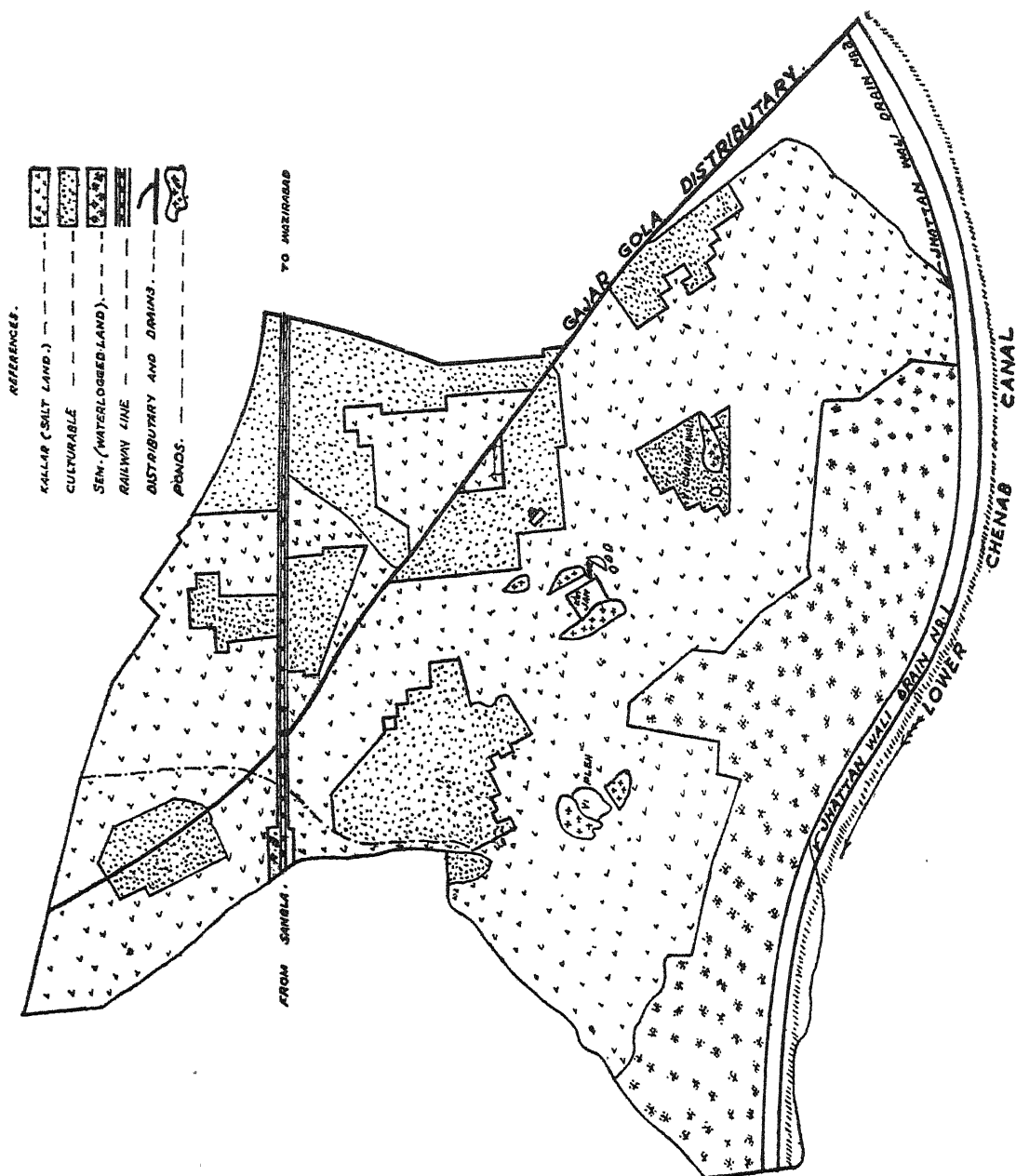


FIG. 5.—CHAKAN WALI RECLAMATION FARM (1926)



WATERLOGGING IN THE PUNJAB

BY

C. W. KING

Director, Irrigation Research, Lahore

In this brief discussion of the causes and cure of the evil of 'Waterlogging' you will very naturally expect me, as Director of the Panjab Irrigation Research Institute, to deal with the research aspects of the problem; and to tell you what has been, and is being done in this Province in the way of research.

In order that you may be able to easily understand the reasons underlying the techniques evolved, and to assess the results in proper perspective, it will be necessary for me to draw a brief picture of the whole historical background.

This broadens the scope of this thesis to such an extent that I am forced to select certain aspects for fairly detailed exposition, to treat others in brief outline only, and to omit many entirely. If, therefore, I omit, or do not sufficiently detail some aspects which may be of special interest to some of you gentlemen, I crave your forbearance.

Before I can deal with possible remedies for the cure of waterlogging, it is first necessary for me to explain the various generally-accepted causes which give rise to it. We must, however, understand very clearly, at the very outset, what the term 'waterlogging' means exactly to various people and in various contexts.

Land Reclamation authorities would usually recognize waterlogging as having occurred in a special sense long before visible signs are evident at ground surface, for it has been found in this Province that when the subsoil water-table rises to within an average ten feet or so of the ground surface it often causes salts from the soil to be brought up to the surface, thus eventually rendering the land unfit for cultivation due to excess of alkalinity. The actual depth of water-table causing this condition varies, of course, and depends mainly on the type of soil existing.

Actually, this is not 'waterlogging' in the true sense, because the presence of salts is not a general characteristic of waterlogged soils, but it is to be so considered if salts are present in harmful concentrations.

Agricultural authorities would recognize waterlogging as having occurred when particular strata of the subsoil, which constitute the feeding zones of the roots of cultivated crops, have become fully saturated, thereby driving out air from the soil-pores and inhibiting the growth of crops, thus ultimately rendering the land unfit for cultivation. These zones occur at various depths below ground level depending on the various types of crops, and are usually from two feet to six feet for the normal range of cultivated crops.

To the layman, however, waterlogging would only be established when the

subsoil water-table has actually risen to ground level, and the ground is saturated with stagnant water. Health authorities would also recognize waterlogging at this stage as it is this stagnant water which breeds the germ carrying mosquitoes that spread malarial fever. But waterlogging technically commences long before the water actually reaches ground level.

When the subject of waterlogging is discussed, it is necessary to adjust the mental concept to the relevant context. In general terms, however, waterlogging may be conveniently defined as that condition of the land which results when the water-table is so high that surface soil is saturated to a degree unfavourable to cultivation, crop-growth and general well-being.

The generally accepted causes of waterlogging were very ably discussed in Paper No. 197, presented at the Panjab Engineering Congress, 1937, by R.B. Bawa Natha Singh. These are summarised, with modifications, in Sharma's book on Irrigation Engineering.

In the various natural cycles of water movement, which manifest themselves from day to day we can recognise many influences at work which tend to add water to the earth's subsoil reservoir; there are other influences, on the other hand, which tend to abstract water from this reservoir. The former may be called 'inflow' factors and the latter 'outflow' factors. Obviously there is no waterlogging menace so long as inflow to day factors do not overbalance the outflow factors.

In a typical *doab*, (i.e., a tract of country lying between two rivers), such as existed before the advent of canal irrigation, the greater portion of the subsoil water-table was invariably far below the ground surface, and well below the bed levels of the bounding rivers.

Inflow factors, tending to raise the water-table, were :—

- (1) Infiltration from the rivers to the water-table
- (2) Percolation of rainfall in the saturated phase.
- (3) Percolation from land, irrigated by wells, in the saturated phase.
- (4) Percolation from land, irrigated by river spill, in the saturated phase.
- (5) Subsoil inflow from the upper regions of the *doab*.

Outflow factors, tending to lower the watertable, were :—

- (1) Subsoil outflow to the lower regions of the *doab*.
- (2) Soil evaporation from the water-table.

In the pre-canal period, while there is no doubt that the level of the subsoil water did fluctuate with the amount of rainfall, no evidence, direct or indirect, exists to show that there was any continuous or progressive rise. A violent rise in a year of heavy rainfall would be vitiated by a sudden drop in a year of severe drought. Had inflow exceeded outflow, waterlogging must have occurred long before even the first canals were excavated. On the other hand, a progressive fall would have taken the water-table very far down.

Since there is nothing to show that either abnormality actually did occur at that period, it may be assumed with reasonable conservatism, that a condition of fairly stable equilibrium must have existed between the inflow and the outflow factors. There would have been periodic rises and falls in subsoil water levels above and below a fairly stable and constant time-average mean position; these deviations would be mainly due to rainfall variations, as other inflow and outflow factors would not vary much.

Imagine now the introduction of canal irrigation by means of a network of canals, their branches, and distributing channels. Two new sources of continued inflow would be introduced, namely, percolation or seepage from the boundaries of the channels, and percolation from fields of the irrigation water in excess of crop requirements, both in the saturated phase. A continuous and rather rapid rise of the water-table would inevitably result, but the rate of rise would generally be non-uniform on account of variability of rainfall percolation.

As the water-table rose progressively higher and higher, in-flow from rivers would reduce more and more due to gradual reduction in head, and subsoil outflow to the lower region would increase due to general steepening of gradient down the *doab*.

The initially rapid rise in level of the subsoil water-table would be gradually and progressively slowed down, the rate of rise generally decreasing more rapidly as the water table rose higher and higher.

When the level of the water-table reached that of the river beds, infiltration from rivers would cease, and any further rise would cause outflow back to the rivers; soil evaporation would also progressively increase with rise of water-table. At the same time, the requirements of efficient and economic irrigation would necessitate proper and adequate drainage, and high intensity of cropping, which latter feature would result in large increase of vegetation over the area.

Thus, at this stage the various influences at work would be generally as summarized below:—

Inflow factors would be.

- (1) Percolation of rainfall in saturated phase.
- (2) Nominal percolation from greatly reduced irrigation from wells and river spills.
- (3) Subsoil inflow from the upper regions of the *doab*.
- (4) Seepage from canals and percolation from fields, both in the saturated phase.

Outflow factors would be.

- (1) Sub-soil outflow to the lower regions of the *doab*.
- (2) Increased soil evaporation from the water-table.
- (3) Outflow to rivers.
- (4) Removal of subsoil water by transpiration of plants.
- (5) Removal of subsoil and surface water by seepage and storm water drains.

At this stage, therefore, outflow influences would once again tend to balance inflow influences, the rise of the water-table would be progressively slowed down, and

eventually a balance would be attained, and a fresh state of equilibrium would result with a new stabilization of the water-table at a progressively higher level.

The stage at which this ultimate stabilization occurred would depend on many circumstances such, for example, as final height of water-table above river beds, ground slopes along and across the *doab*, intensity of soil evaporation and magnitude of plant transpiration; and waterlogging would result only if the water-table were finally stabilized too close to the ground surface.

Thus, while the evil of waterlogging, when it appears, can be reasonably attributed to the introduction of canal irrigation, it does not necessarily follow, that it is an inevitable result of the latter. In the United Provinces for example, the introduction of canal irrigation has not so far resulted in waterlogging of the land to any appreciable extent, whereas in the Panjab the problem is acute.

From what has just been said regarding the generally accepted causes of waterlogging, it is quite evident that mitigation if not cure, of the evil lies in abstracting as much water as possible from the subsoil reservoir in order to lower the water-table, or at least, to control the latter at a sufficient depth below the ground surface.

Remedial measures, which suggest themselves, are :—

- (1) Reduction of percolation from canals, branches, distributing channels and water-courses, by lining their envelopes with impermeable linings.

Large scale adoption of this remedy would be, in general, prohibitively costly.

- (2) Lowering of the water levels in canals by deepening the beds.

The applicability of this remedy is limited, not only because of consequent loss of much-needed field command for flow irrigation, but also because any cutting through the soil crust would tend to increase inflow rather than to reduce it.

- (3) Excavation of intercepting seepage drains running along channels in reaches where the water table is very high, with the object of quickly carrying away part of the seepage, thus preventing it from percolating down, and also to lower water-table slightly by steepening seepage gradients.

- (4) Excavation of networks of artificial seepage and storm water drains, or canalization of natural channels, such as old river creeks and spill channels, to extract and to rapidly carry away water from surface and subsoil to suitable outfalls.

It has been found that such drains can adequately control only relatively narrow belts and therefore require to be spaced at relatively close intervals; this makes the general application of this remedy too costly, and it is, therefore, not a universal panacea, though useful under special circumstances in particular tracts.

- (5) Restriction of irrigation by reduction of intensity, by conversion of perennial canals to non-perennial canals, by resorting to periodical canal closures, or by replacement of canal irrigation by well irrigation.

None of these methods appeal to the cultivator.

- (6) Economy in the use of water by reducing water allowances, introduction of the *Khal-Kiari* system and similar measures. The cultivator has not taken kindly to these methods so far.
- (7) Pumping of subsoil water by means of tube wells.
- (8) Collecting surface water in suitable depressions and pumping out accumulations.

It is not possible, in the scope of this thesis to discuss in detail the merits and demerits of all these remedial measures. The most important are lining, judicious drainage and tube-well pumping.

Restriction of irrigation and economy in the use of canal water can only be successfully employed with wide-scale co-operation of cultivators, who are generally not yet educated up to that pitch.

I must pass on, now, to a brief resume of the history of the rise and spread of the waterlogging evil in the Punjab, and the various measures adopted to cope with it.

Attention was first focussed on the menace due to conditions which developed on the Western Jamna Canal in the first half of the last century.

This canal largely followed the alignments of the original Jamna Canal built about the middle of the 14th Century by order of the Emperor Feroze Shah Tughlak, and later remodelled and extended by the Emperors Akbar and Shah Jehan.

Natural channels were utilized as far as possible, for economy, and depressions were crossed on earthen banks with no provision for continuity of intercepted drainages. Matters were aggravated by further hasty construction of other channels on faulty alignments due to the famine of 1832-33. As a result, large swamps were formed, and over numerous areas the ground surface was completely waterlogged. Malaria appeared, spread yearly, and reached such virulent form during 1841-1843, that the cantonment of Karnal was abandoned in 1844.

A commission was appointed to investigate the matter, and a further enquiry was later made by Surgeon Major Adam Taylor. As a result of these inquiries, wholesale remodelling was started in 1873, the canal system was properly re-aligned and adequate drainage provided.

This action cured the trouble, which, however, was not waterlogging in the technical sense, but was due merely to obstruction of drainages, with consequent formation of swamps.

The first case of real waterlogging appears to have occurred in 1870 on the Sirhind Canal, with the abnormal rising of the water-table in certain areas. Local officers attributed this rise to rainfall, but data were quite inadequate to permit of systematic investigation. Consequently, observations of water levels in open wells, scattered over the tract were started in that year, and have been continued since, in all canal irrigated tracts of the Province. In addition, a large number of rain gauge stations have also been established, discharges of rivers and canals are regularly observed, and gauges of rivers and canals are recorded daily. Availability of all these data has made it possible to examine the general rise of water-table with reference to the factors which may be operating.

With the further opening-up of the Province to canal irrigation, waterlogging has now spread to practically all canal systems, a peculiar feature being that the evil has become apparent usually in the upper reaches of canals, while areas in the lower reaches are more or less unaffected.

One, and probably the main, reason for this peculiarity was revealed by a geodetic survey carried out in 1934 by Wilsdon and Bose of the Irrigation Research Institute. Use of a special instrument, named the Eotvös Gravity Balance, revealed the existence of a subterranean rock ridge stretching across the Province in a north-westerly-south-easterly direction, and dividing the underground region into two nearly equal parts. This ridge appears to start in the Salt Range and to continue on, passing north of Delhi and extending through the United Provinces. Out crops are visible at Khushab, Sargodha, Chiniot and Sangla. As the Panjab rivers, and therefore the *doabs* run generally from north east to south-west, this ridge crosses them, roughly, at right angles, and subsoil flow down a *doab* is, hence, across the ridge and not along it. The subsoil water-table is thus behaving differently in the two parts created by the existence of the ridge; in the upper part it has approached or reached ground surface and is causing the appearance and spread of waterlogging; downstream of the ridge, however, it is still at a considerable distance below ground level, though steadily rising, and waterlogging is not yet evident in the lower areas of the canal systems.

Investigations of the rising of water-table have so far been mainly confined to the upper areas due to the appearance of waterlogging there; they are to be extended to the lower areas also.

Malhotra of the Institute actually carried out one such investigation of the lower areas of the Rechna Doab in 1938 and found that either the same factors were operating as in the higher reaches, or that the water-table above the ridge was directly influencing that below the ridge. It would appear that the upstream water has headed up and is now topping the ridge.

Government took serious notice of the waterlogging menace for the first time in 1917, when a 'Drainage Board' was set up to investigate its causes and effects, and to suggest remedies. Nothing useful was done during the next decade due to financial stringency. In 1925 this Board was split up into a 'Waterlogging Investigation Committee' and a 'Rural Sanitary Board.' The menace in the meantime, assumed such alarming proportions that in 1927 the first Waterlogging Conference was convened with His Excellency the Governor as President, and an Officer was placed on special duty to collect all correspondence on the subject. It was decided that, as a first measure, Kharif closures should be tried and irrigation should be restricted in the threatened areas. As a result of the investigations of this Committee, Lindley, in 1928, gave a forecast of areas likely to be waterlogged within the next decade if the prevailing rate of rise continued. An investigation was made in 1937 to check up this forecast. Waterlogged areas were found to be considerably less than predicted by Lindley, due to the fact that the rate of rise slowed up as the water-table rose and finally stopped. Examination of the soil crust showed that the rise stopped when water-table touched the bottom of the crust; this phenomenon is probably peculiar to the Punjab and due to alkalinity rendering the crust impermeable.

After the heavy rains of 1926, attention was devoted to the Upper Chenab Canal, and during 1926-33, some remedial measures were tried by excavating intercepting seepage drains, lowering falls and sinking a number of tube-wells at Gujranwala. These measures produced only a very local effect.

In the meantime, in 1927, Wilsdon and Sarathy of the Institute carried out the first systematic study of available data for the portions of the Rechna and Chaj Doabs lying upstream of the ridge. They concluded that both rainfall and irrigation contributed to the rise of water-table, the major cause of the rise being, however, the monsoon rainfall. They recommended annual closures as a remedy, but cultivators objected strongly to Kharif closures and the measure was later abandoned. In 1933, data for the Upper Chenab Canal areas, upstream of the ridge, were examined by McKenzie-Taylor, Malhotra and Metha of the Institute. Their conclusions confirmed those of Wilsdon and Sarathy.

These conclusions focussed attention on the question of efficacy of storm water drains to carry away flood and rain water and in 1932-1933, the Waterlogging Board decided that surface drains were the best remedy and approved the principle of a five year programme of drainage construction. From 1933 to 1939, therefore, a big programme of drainage construction was undertaken in the Rechna and Chaj Doabs; that was the first appreciable effort made to control waterlogging by drainage.

In the meantime the protagonists of tube-well pumping had been pressing for its recognition as a remedial measure, and in 1935 two waterlogging conferences were held, at the second of which it was definitely decided to postpone tube-well programmes, to avoid diverting funds from the 5-year drainage plan. In 1936, the policy of constructing branch drains was approved.

The relative importance of canal seepage as an influence tending to add to the underground reservoir, had been meanwhile engaging increasing attention, and in 1930 Malhotra of the Institute investigated seepage losses from the Jhang Branch of the Lower Chenab Canal, and for a reach of the Kasur Branch of the Upper Bari Doab Canal; he found the losses to be 13 cusecs and $7\frac{1}{2}$ cusecs respectively per million square feet of wetted perimeter.

In 1938, Vaidhianathan of the Institute investigated seepage losses of the Lower Bari Doab Canal; he found them to be 5 cusecs per million square feet. Crump, at the same time, checked Malhotra's findings from the Kasur Branch of the Upper Bari Doab Canal by using sharp-crested weirs of the Rehbock type, and showed that the figure of $7\frac{1}{2}$ cusecs per million square feet is probably correct. As a result of these investigations, the Waterlogging Board decided, in 1938, to consider the lining of channels as an anti-waterlogging measure.

Blench, also, made a further and detailed investigation of seepage losses in 1939; he found that the average seepage losses of Panjab Canals were 8 cusecs per million square feet.

In 1939-40, Crump was placed on special duty to carry out waterlogging investigations, which were further continued by Blench. They reached the following conclusions :—

- (1) In the lower Chenab Canal area, seepage from the canal system was the major influence adding to the water table, whereas on the Upper

Chenab Canal it, was the percolation from field irrigation.

- (2) Lining of a channel would effectively prevent 90% of the seepage from reaching the subsoil.
- (3) Seepage drains were relatively very expensive when compared with lining.

During the War years, 1939-45, very little progress was made on implementing the decisions taken at the various conferences. At the 1944 Conference, however, while it was decided that the drainage work should continue, the measures involving lining and tube-well pumping were also considered, and in 1945 it was again stressed that attention should be concentrated on these three. During the period 1944-46, therefore, following the very heavy monsoon of 1944, a very big programme of surface and seepage drains was undertaken and the Northern Drainage Circle was created. Tubewell Scheme No. 1, providing 60 tube-wells along the Upper Gugera Branch near Chuharkana and 60 tube-wells along the Upper Chenab Canal, was also put in hand.

The latest meeting of the Waterlogging Board took place on the 15th of February, this year. It was decided that, as the problem is now so acute and so important, Government should be moved to place the waterlogging problem, and kindred problems of reclamation, flood control, etc., in charge of a special senior officer preferably of the rank of Chief Engineer.

I trust that I have been able so far to indicate clearly the vastness of the problem which now confronts us here.

It will be obvious that at the present time the most practical remedial measures are, as I have already stated, judicious drainage, lining of channels, and tube-well pumping.

Some of the investigations carried out in the Irrigation Research Institute, in connection with the waterlogging problem, have been briefly described by me while unfolding the historical background. These investigations were mainly of a statistical nature, involving the mathematical analysis of data supplied.

I will, now, briefly outline the more important experimental research undertaken here.

Experiments conducted during 1939-1942, in connection with testing the efficiency of seepage drains for lowering the subsoil water-table, showed that while these drains are quite effective in removing free gravitational water, they are not effective in decreasing the saturated capillary moisture, unless they are so deep, as to induce negative pressure in capillary columns, sufficient to counterbalance the capillary air-soil-water forces at the menisci of the fringe. It has been found that the capillary forces depend on the nature of the soil composing the stratum and not on its thickness; and for the average type of soil in the Panjab, it has been found that the depth of seepage drains should be at least seven feet. With such a depth, however, it would be difficult to control weed growth, and constant blocking of the waterway by weeds renders the drains ineffective and very inefficient. Moreover, the big depths of excavation make these drains relatively costly. Seepage drains, however, do serve their purpose under special circumstances.

Lining is a subject on which a vast amount of knowledge and experience is still to be gained. A comprehensive series of tests on various types of lining have since been carried out here, extending over the past five years or so. The following types of lining have been tested.

(1) *Chemical Linings*.—It was found in 1937-38 that sodium-clay or soil containing certain sodium salts is very impervious and admits very low seepage. Tests in the laboratory showed that soil mixed with about 0.2% of sodium carbonate is practically impervious under a low head of water. Field tests, however, were not satisfactory, as the lining was found to deteriorate after two or three seasons.

(2) *Lining with Bituminized Fabrics and Mastics*.—About 50 different types of bitumen-impreganated fabrics have been tested in the Institute for suitability as linings. Only a few were found able to withstand a water head of 20 feet, without serious seepage loss, and practically all suffered serious deterioration after immersion in water for about six months. Some bituminized mastics were also tried out and a few gave reasonable results, but were found impracticable in the field.

So far no really successful types have been developed and the work is at present in abeyance due to lack of staff after the partition.

(3) *Concrete and Brick Linings*.—Tests on these included :—

(a) Lime-grit lining of the type used on the Bikanir Canal, which was subsequently renamed the Gang Canal.

This type of lining had proved quite successful on the canal itself, but laboratory results were very disappointing, as the concrete, made from materials similar to those used on the canal, was neither watertight nor durable. Its success at site was probably due to the existence of an extensive impervious clay layer below the canal bed.

(b) Lining with a double layer of flat bricks separated by a half inch layer of 1 : 3 cement-sand plaster, such as used on the Haveli Canal.

Tests on this type of lining showed it to be sufficiently durable and also impermeable under a 20-feet water head, but expectations were not fulfilled at the canal itself as the resulting lining allowed appreciable seepage; this, however, was probably due largely to constructional defects, such as incomplete compaction of the sub-grade on which it was laid, inadequate provision for drainage of banks, etc.

(c) Lining of concretes with 1 : 2 : 4 and 1 : 3 : 6 mixes, using stone or brick as coarse aggregate.

The tests made here have shown that a 4" thick slab of 1 : 3 : 6 mix is impervious under a water head of 20 feet, and also that from this aspect, stone aggregate does not possess any special advantages over brick aggregate, which can hence be used where high strength is not of paramount importance. Further tests are being carried out in this connection.

(4) *Soil, Soil cement and bituminized soil linings*.—Except for tracts in the North Western region of the Punjab Province, the average soil generally contains from 10% to 20% of clay.

Tests on these soils, in the Institute, showed that if such a soil is properly compacted under conditions of optimum moisture content, it is practically impervious to a water head of 20 feet. Its period of durability is, however, short and tests showed serious deterioration after three cycles of alternate wetting and drying, each cycle extending over a period of a month.

To increase durability, further tests were carried out after admixing small percentages of cement with the soil, and then compacting the mixture under optimum moisture conditions. The best average result was found to be a soil containing not less than 7% clay admixed with 5% of its bulk of cement. Properly compacted slabs of 4" to 6" thickness withstood water heads up to 20 feet, but developed hair cracks under the wet-dry cyclic tests. To remedy this the mixture was reinforced with various materials and it was found that when coir fibres were added the formation of cracks was considerably reduced. The results are promising, but so far field tests have not been possible. As soil cement linings have been successfully used in other countries, this line of research is promising and is being followed up.

So far, it has not been possible to investigate the potentialities of bituminized soils, and work on this will be taken up as soon as circumstances permit.

(5) Air lock linings.

It has been found that an unsaturated soil, under a head of water, takes appreciable time to become saturated as contained air has to be expelled before percolation can take place.

Khan Bahadur Abdul Ghafoor, Chief Engineer, Irrigation Works, Punjab, has drawn attention to this fact, which is now being tested at the Institute for its potentiality as a means of lining of canals. If a layer of sand is sandwiched between two well-compacted and air-tight layers of clay, any water seeping down and penetrating the upper layer will be stopped by the increased pressure of the compressed air imprisoned in the sand layer. This sandwich, placed below the bed of a canal, should greatly minimize seepage. The tests have been started very recently and have so far not yielded any significant pointers.

Of all these methods of lining so far tried out, those using the double brick-cement sandwich and 1: 3: 6: cement concrete linings have given the best results: the new air lock lining now under test also looks promising so far. Our activities on linings are restricted at present due to lack of staff, but the question of lining is so important that it is being given as much attention as possible.

A vast amount of work has also been done on experiments in connection with tube-well pumping, which it is not possible to describe in detail now.

The main techniques developed have been the sand-tank method and the electrical analogy method, and some field tests have also been carried out.

The work is still in progress and has not yet reached finality, but results indicate that a series of tube-wells sunk between 600'-1000' away from a canal give the best result so far as extraction of subsoil water is concerned. Three quarters to four-fifths of their discharge is from the subsoil water and only the balance from the canal seepage. Many wells, however have already been sunk just alongside the canal, and these have been

shown by laboratory tests to draw only 50% to 25% of their output from the subsoil and the major portion from the canal. In addition, they cause greatly increased seepage losses; this does not cause any practical difficulty as they discharge back to the canal, but their efficiency is very much lower than that of wells sunk further out, so far as the extraction of subsoil water is concerned.

Now it is very probable that if wells sunk at the correct distance away from a canal are shielded by wells sunk alongside the canal, the inefficiencies may be still further increased, and tests are now in progress to determine whether this will be so and to what extent.

The answer will determine whether these wells already sunk alongside channels should be withdrawn and resunk in the correct position, or whether they should be allowed to remain and be supplemented by a second row.

When a battery of wells is sunk the question of mutual interference in output assumes importance, and tests are also in progress to determine how far apart wells should be placed.

It is envisaged that it will require about 5000 tube-wells pumping $1\frac{1}{2}$ to 2 cusecs each to keep the subsoil water-table in the Province at not less than 10 feet or so below ground surface. About 500 wells have been sunk so far and the work is being actively pushed on.

These wells will be worked with pumps operated by electricity which will be supplied by the Rasul Hydel Scheme. This scheme will not fructify for another 2 or 3 years yet, and it may perhaps be necessary to develop power quickly by means of small localized generating sets run by water-wheels situated at suitable canal falls.

Some tests were, therefore, recently carried out in the Institute on various types of water-wheels with very encouraging results. The work is temporarily in abeyance due to lack of staff and increased incidence of more immediate problems, but will be re-started shortly.

I regret it has not been possible for me, in the time at my disposal, to describe our activities in greater detail, but those of you who have visited the Institute and have seen what is being done there, will now have a good idea, not only of the wide ramifications of the waterlogging problem, but also of what we are doing in the endeavour to stop further spread of the evil.

I would finally like to express my great appreciation of the very notable help that was rendered by Dr. Nazir Ahmad, Physicist, in the application of this thesis.

TUBEWELLS AS A MEANS OF OVERCOMING WATERLOGGING

BY

A. HAMID

Executive Engineer, Rechna Tube-Well Division, Lahore

It is said that, in the West Punjab, about half a lac acres of land are becoming waterlogged, or are being transformed into *Thur* every year. This appears rather exaggerated, but even if it is not so, this gives us the magnitude of the seriousness of the problem. This rate of deterioration or even 50% of it, is extremely high and it cannot be tolerated to see so much land being put out of commission. The trouble is believed to be due to the general rise in the water table. Means must, therefore, be found to check further rise and to lower the water table to such a depth as to keep the salts depressed in the whole of the cultivated land. For practical estimation it is considered that if the sub-soil water level is kept at an average depth of 15 feet below the ground surface, it would not harm the crops, but if the water is above this level, then capillary action of the soil will draw water up to the surface and along with it will raise whatever salts are in the soil crust to the root zone of crops and thence to the ground surface; where they manifest themselves as efflorescence in the winter season. If they are in sufficient quantity, they are lethal to crops, both by toxic effect and by alteration in the nature of the soil.

In this note the author has tried to discuss the various aspects of tube well pumping as a means of overcoming waterlogging.

He has drawn freely from the technical report of Dr. Nazir Ahmad and other publications of the Irrigation Research Institute, Lahore Paragraphs enclosed in inverted commas are direct quotations from papers mentioned in the Bibliography.

Sources of Accretion. The following are the sources of accretion :—

- (1) Rainfall including rain water whose normal run-off is obstructed.
- (2) Seepage from rivers, channels and distributories. This may preponderate all other causes.
- (3) Inflow of sub-soil water from areas where the water table is high.
- (4) Excess irrigation, i.e., the portion of irrigation water that returns to the subsoil. This is usually assumed to be one third.

It must be remembered that just as there is accretion to the sub-soil there is also run-off or overflow from the sub-soil taking place all the time. The ordinary channels of run-off are :—

- (i) Seepage into river beds during times of low supplies.
- (ii) Continued flow of water-table in the direction of the sea.

Thus, there is a constant circulation or renewal of the underground supply and

the rate of this circulation depends upon the nature of the stratum. This continued flow of water towards the sea, is sometimes the violently obstructed by a submerged rock or ridge. This raises the water-table in the vicinity and, eventually, the water-table stabilises at such a slope that the inflow and outflow are balanced. The slope it finally adopts depends upon the volume of water and the rate of flow i.e., mean transmission constant of the sub-soil. If this slope approaches or rises to the surface, the land becomes waterlogged.

According to geologists, there are three crests of crustal warpings sweeping across Northern India. The middle one of these warps runs from Shahpur, Sargodha, to Delhi through Sangla, and thence through Allahabad and Bhagalpur to Shillong. In the Punjab, the direction of sub-soil flow is roughly normal to the main crustal warps and is impeded by the second one on the Sargodha-Delhi line.

The water depth maps of Rechna and Chaj Doabs clearly indicate that very high rise in water level has occurred only on the right side of the middle crustal warping; and its complete absence on the opposite side suggests that this crustal warp, together with an impervious clay layer which occurs all over the Punjab between 85 to 120 ft, assists in making vast basins to become waterlogged.

Before proceeding further, we should understand the meanings of 'transmission constant.'

The transmission constant is defined by scientists as the velocity of water per second per unit gradient; whereas the engineers define it as the quantity of water which passes through a unit area of cross section per second per unit gradient.

The quantity of water flowing through the medium per unit cross sectional area will depend upon the porosity of the medium. The greater the porosity the greater the flow. The porosity, as we know, depends upon various factors such as :—

- (1) Shape and arrangement of grains forming the medium.
- (2) Size of grain.
- (3) The degree and assortment of grains.
- (4) The cementation and compaction to which these are subjected.

Well-sorted deposits of uncemented gravel, sand or silt have a high porosity regardless of whether they consist of large or small grains. If, however, the material is poorly sorted, small particles occupy the spaces between the large ones, still smaller ones occupy the space between these particles, and so on, with the result that the porosity is greatly reduced.

Since the transmission constant of a medium cannot be altered, we have to reduce the volume of water reaching the water-table.

The programme of prevention and cure of waterlogging must have, as its ultimate object, the control of October water table, to prevent it from supplying water to the evapo-transpiration zone. Wherever levels have been higher than this and salts have been present in the soil crust, the lowering of the water table must be followed by reclamation.

The most effective method for removal of water from the water table is

considered to be Tubewell Pumping. There is no doubt that with sufficient power and plant, tubewell pumping can control and lower the water table to any reasonable prescribed limit.

The means of keeping the water-table down to the requisite level are two-fold :—

- (1) Reduction of addition to the water-table.
- (2) Removal of water from the water-table.

*“Tubewell Capacity :—*To calculate the number of tubewells required to lower the water-table it will be presumed that the source of accretion is seepage from canals. The total seepage from canals is then calculated and the number of tubewells required to deal with that area is determined. For instance, it is not unreasonable to accept an estimate of 3,100 cusecs as the total volume of pumping necessary to stabilise the water table in the Rechna Doab alone. To lower the water table to 15 feet, say in ten years, it is estimated that it would require an additional 620 cusecs to be pumped. To deal with the discharge of 3,720 cusecs it would be necessary to have 1,860 tubewells of 2 cusecs capacity. In the Rasul Tubewell Project provision is, however, made only for 1,860 tubewells in both Rechna and Chaj Doabs. It is, therefore, evident that the number of tubewells provided are insufficient to achieve the object, but probably the deficiency is intended to be made good by other means, such as drains, anti-waterlogging closures of canals, etc.”

*Location of Tubewells :—*In the case of Rasul Tubewells Project, tubewells are being usually located on the canals of more than 500 cusecs capacity, where the water table is less than 10 feet below the ground level.

*Position of Tubewells :—*When the scheme was started, the opinion regarding the siting of tubewells was divided. Eminent engineers like Mr. Haigh were of the opinion that the tubewells should be sited near the canal, as placing the wells within the canal boundary has also certain economic advantages, such as :—

- (i) saving in acquisition of lands for the wells and delivery channels and
- (ii) reduction in the cost of the channels themselves, which is very high in view of the fact that they have to command the canal.

The installation of tubewells close to the canal was carried out with the idea that with continuous working of wells, the cone of depression would extend below the canal and it might be possible to lower the level beyond the capillary height of the soil and the ultimate breakage of saturation connection between the seepage of canal and the water-table.

It was probably appreciated by the authors of the scheme that (1) It would be very undesirable to lower the water-table in the vicinity of the canal without breaking the saturation connection, as to do so would certainly increase absorption. (2) If the wells are placed away from the canals the lowering at the canal would not be so effective. There would be a slope in the water-table from the canal to the wells. (3) If the wells are at the canals the water-table at the canal will have a minimum level and moreover, the local lowering of the infiltration cones will assist in rapidly breaking the saturation connection. On the other hand, Sir William Stampe was of the opinion that it would be difficult to break the saturation connection with the proposed number

of tubewells and the best course would be to locate wells at such a distance from the canal that depression cones should not extend underneath it. Experiments were carried out by the Irrigation Research Institute, Lahore, on the Upper Gujara Branch at R. D. 1,12,000 to determine the correctness or otherwise of the objection of installing the tubewells near the canal.

“[The main purpose of investigation was to find :—

- (1) What is the optimum distance at which the tubewells can be placed to produce the maximum effect in de-watering the sub-soil under the bed of the canal and also lowering the water-table ?
- (2) Are the strata in the Doab such as to give a reasonably good yield of water from each well and can this be used for Irrigation ?
- (3) By putting tubewells, are we only pumping water from the canals and putting it back, or what proportion is taken from the sub-soil and from the canal ?
- (4) (a) The moisture content.
(b) Conductivity.
(c) Temperature.
(d) Mechanical analysis.
(e) Analysis of water and determination of other minor observations.

For the purpose of this experiment a number of pipes were installed according to plan. These pipes were situated near the canal extending to about 2,000 feet away.

Three tanks were also constructed at a distance of 1,000 ft. from each other. The first tank being near the two tubewells was installed at a distance of 65 feet from the canal. Seepage from these tanks was to indicate the amount of water drawn from the canal, the extent of the influence of the tubewells and of the nature of de-saturation of the sub-soil.

Description of Experimental Site.

Well System :—At the site of experiments, tubewells have been installed in groups of three ; each being 500 ft. apart and at a distance of 65 ft. from the canal. The wells are sunk to an average depth of 250 feet. The soil at the site has a layer of silt and clay extending to a depth varying between 10 to 20 ft.

The percentages of silt and clay and sand were found from five soil samples taken from five different places up to a depth of 10 ft.

The results of mechanical analysis of the samples were recorded. The percentage of silt and clay seemed to vary from 15 to 29% for each ingradient, while the rest was sand, both fine and coarse.

As for the profile of soil at a depth greater than 10 ft., a visual record of the two tubewells confirmed that clay extended, at some places, to a maximum depth of 20 feet below the natural surface.

Experimental Set up :—To record the sub-soil water level, 129 observation pipes were installed. A tank 400 ft. \times 50 ft. \times 4 ft. was constructed between two wells of the group say A & B and ten observation pipes, five on either side of the tank along the length of the canal were installed to record the changes of sub-soil water level in the tank.

Two more tanks of the same dimension were constructed, the second and third ones being placed at a distance of 1,000 feet from the first tank.

The central tank had also two tubewells D & E similar to tank No. 1.

No tubewells were installed on tank No. 3.

Observations

The following observations were taken during the test :—

Seepage Observation of Tanks :— These were carried out for all the three tanks. Seepage was measured by observing the fall in level of water every twenty-four hours. The amount of evaporation was also taken into account. After each observation the level of water in the tank was brought back to its original position so that the seepage always took place under the same head of water.

The programme adopted for taking observations was as follows :—

- (a) Ten days cycle of working and stopping the wells.
- (b) Continuous working of pumps for a long time.
- (c) Alternate working and stopping of the wells AB & DE.

(a)—Ten day's cycle of working and stopping the wells. The following conclusions were drawn :—

(1) Pumping increased the seepage as well as the head, the increase being maximum for tank No. 1, less for tank No. 2 and least for tank No. 3.

(2) The ratio of the two seepages in a cycle was nearly 2.2 for tank No. 1, 1.6 for tank No. 2 and 1.4 for tank No. 3.

(3) Pumping increased the head practically to the same level for tanks No. 1 and 2, as both had similar wells at their ends.

(4) The lowering of S.S.W.L., due to working of wells was not lasting.

(5) There was no direct effect of wells on the seepage of tank No. 3 which is 1,000 ft. away from the nearest well.

(b) Continuous working of wells:—These experiments indicated :—

(1) Continuous working of wells for 6 months increased the head for tanks.

(2) The rate of increase was rapid in the beginning and fell slowly with time.

(3) No definite conclusion could be drawn about the seepage.

(c) Alternate Working of Wells AB & DE.

The following programme was followed :—

(1) Alternate working of wells AB & DE.

(2) Repetition of ten days cycle of working and stopping.

(3) Repetition of (1) or (2).

The following conclusions were drawn from these experiments :—

(1) The seepage from tanks No. 2 and 3, without working the wells, varied between 5 to 6 cusecs per million sq. ft. The normal seepage from canal at this site can be assumed to have this value.

(2) The seepage of tank No. 1 and 2, both of which had tubewells adjacent to them, was nearly double, (2.2 times for tank No. 1 and 1.6 times for tank No. 2) when the wells were working. Indirectly, the working of wells doubled the seepage of canal normally taking place under this head.

- (3) The working of wells had very little effect on increasing the seepage 1,000 ft. away and absolutely no effect 2,000 ft. away.
- (4) The lowering of S.S.W.L. near the tanks, in a ten days cycle, was not permanent, for the water attained its original level as soon as the wells stopped working.

Sub-Soil Water.

As already mentioned above, 129 pipes were installed for observation. The sounding of water level in all the pipes was carried out at least once every ten days but often every 5th day :—

- (a) Ten days cycle of working and closing the wells.

These observations were taken from the 15th of December, 1945, to 13th October, 1946. During the working period the S.S.W.L. was lowered, but always regained its original level during the closure period. The effect of pumping seemed to be extensive but not permanent.

- (b) Effect on S.S.W.L. when the Wells were Run Continuously for 6 Months.

These observations were carried out from 13th October, 1946, to 31st March, 1947. A closure of canal, the from 10th December to 12th January and excessive seepage of the tanks after scraping their beds, also took place during the period.

The maximum lowering of S.S.W.L. took place 17 days after closure (13. 1. 47). and remained at this level for another 20 days (31-1-47) after which it slowly rose to attain a final stable level in a fortnight (23. 3. 47).

The table given below illustrates the R. L's of S.S. Water on the above mentioned dates as compared to the original level.

TABLE

Distance from right bank of canal		S.S.W.R.L. on 31. 1. 47.	S.S.W.R.L. on 28. 3. 47.	S.S.W.R.L. on 19. 11. 46
0	L	666.9	668.5	674.4
500	L	669.0	669.4	674.0
1,000	L	670.2	670.2	674.1
1,500	L	670.8	670.8	674.1
2,000	L	671.3	671.3	674.2
5,000	R	667.5	667.6	673.6
1,000	R	667.5	667.8	675.5
1,500	R	669.65	668.4	673.4
2,000	R	669.5	669.0	673.4

(c) Effect on S.S.W.L. when the Wells Nos. A,B. & D.E. are Run in Rotation.

This programme as already mentioned, was carried out for about two months. The effect of alternate working of wells Nos. A,B. & D.E. was noted. The continuous working and stopping of wells was also repeated again.

Summary of the Results.

1. Seepage of the canal, at the site of the experiment, seemed to be 5 to 6 cusecs per million sq. ft.
2. With the lowering of S.S.W.L. by about 5 ft., due to pumping, the seepage had increased to nearly double the normal value.
3. The lowering of S.S.W.L. in ten days of the working period was not permanent, as the water regained its original position as soon as the wells stopped working.
4. Continuous working of the well for more than a year lowered the S.S.W.L. below the canal bed by nearly 4 ft.
4. (a) Further lowering beyond 4 ft. was much slower and results plotted gave asymptotic curves.
5. This lowering was permanent only if the wells were kept working.
6. Assuming 10 ft. lowering of S.S.W.L. to be necessary for breaking the saturated connection, some years of continuous pumping will be essential to attain this level.
7. By shifting the wells away from their present position, say 500 ft., the reduction in seepage of canal, taking place due to pumping, will be nearly 70%.
8. Wells working 1,000 ft. away seemed to have little effect on the seepage of the canal.

Moisture content : The measurement of the moisture content was carried out for soil samples taken before and after pumping. It was observed that the moisture content decreased as the tubewells were worked. These observations were carried out to see if the saturation could be broken and retained. Un-saturation caused by the lowering of S.S.W.L. was recorded.

Conductivity: The Conductivity of the water is an index of the salt content. The canal water has usually a lower salt content than sub-soil water drawn from wells and tanks. When the conductivity is determined, it is possible to say whether water is good for irrigation. The conductivity of canal water varied from 130 to 180 units, that of the two tube-wells A & B near the canal, from 180 to 210, and that of D & E, one thousand feet away from the canal from 250 to 310. The conductivity of tubewells near the canal was less than that of the tubewells 1,000 ft. away, indicating that the tubewell near the canal had more admixture of the canal water than that 1,000 ft. away. The conductivities of the tank water were about 210, 160 and 280 units for tanks Nos. 1, 2 & 3, respectively. The increasing order of conductivity showed the influence of the distance of the tanks from the canal. The electrical conductivity of water of the canal, tubewells and tanks was occasionally measured by a megger.

Determination of Temperature : The temperatures of the canal, tubewell and tank water were recorded. These were taken to reduce seepage to standard conditions and also in estimating evaporation etc.

Mechanical Analysis : These observations were taken to assist in the correlation of results.]''

Depth of Tubewells : The tubewells, as mentioned in the beginning of this note, have to perform two functions. One is to cause an unsaturation of the sub-soil below the bed of the canal, and the other is to extract water from the sub-soil to lower the water table.

Regarding the first point; the unsaturation of the bed of the canal can be possible only if more water is abstracted from the sub-soil than what is seeping. When the maximum head is produced and the saturation passes down through the various stages to unsaturation, a tremendous negative pressure is produced in the interstices of the soil. This depends on the nature of the strata. The abstraction of water increases this pressure in order to bring it to that at a phreatic surface. If the tubewell abstracts water quicker than supply and breaks off the connection, the seepage will decrease. After the decrease has been obtained, it may not be possible to retain it at the unsaturated stage, unless pumping is continued. The number of wells, as stated before, may have to be increased in such cases to break the connection and maintain it at that stage.

In case of de-saturating of soil there are three stages in the moisture cycle. The first stage is the most important, as the desaturation and decrease of seepage from the canal depends on it. Where water is pumped, the state of saturation passes down to what is called a funicular stage. At this stage a pressure deficiency is caused in the soil. This is known to have a value of $12.9 \frac{T}{r}$, where 'T' is the surface tension, and 'r' is radius of the particales. If the radius of the particales is great, as is the case with sands, then the condition is favourable, but the seepage will be very high from the canal and pumps will have to counteract it and even abstract more water to lower the water-table. If, on the other hand, the strata is fine silt or clay, the seepage will be low, but the negative pressure will be high and pumps may not be able to abstract water from it. If the strata is fine silt or clay and the seepage is low, then that reach of the canal may not be the cause of waterlogging and is not of practical interest. But the saturation within that may remain.

Regarding the second point, deep tubewells may have a good discharge, but the major part of the discharge may come from deeper strata, where the sand has a good permeability. If this happens, the tubewells may supply water, good in quality and quantity, but if the intervening strata is of very low permeability, then the water-table may not be depressed as might be expected. This is a possibility in a deep well and depends mainly on the strata. A reference to the strata charts for Upper Chenab Canal and Rakh Branch will make this point very clear. In all such cases, sinking below clayey stratum is futile from the point of view of waterlogging.

An investigation should, therefore, be conducted with shallower wells in larger numbers. In these wells porous reinforced concrete pipes, or any other cheap and effective type of strainer, should be sunk to the depth of the fine sand stratum or clay belt.

An investigation with horizontal wells may also be undertaken. There is practical difficulty in boring a horizontal well, but it may be possible to overcome that. With respect to the discharge, a horizontal well will yield better than a vertical one under suitable conditions.

“[Discharge: Theoretically the discharge of a tubewell is denoted by the formula.

$$Q = \frac{H - h_o}{\log \frac{R}{r_o}} \times C$$

Where $H - h_o$ = depression head

R —radius of depression

r_o = radius of strainer and C = Constant $\frac{\pi \times r \times G \times K \times h}{\mu}$

Where $\frac{r}{u}$ is usually assumed as 1

g = gravity = 32.2

K = transmission constant

h = depth or length of strainer.

It will be observed that the discharge depends on so many factors that it is not possible to find out exactly the discharge of a tubewell, but for practical purpose it may be taken to depend upon the following:—

1. Surface area of a strainer = π times diameter of strainer, multiplied by its length; call it ‘A’.

2. Depression head: This is the difference in water levels in a tubewell and surrounding soil before pumping and that in the tubewell during pumping. This head causes flow of water into the tubewell and the discharge is proportional to this head upto a point. The limit is reached when the velocity of flow exceeds the critical velocity for the sands around the strainers, and, therefore, a bigger drop and discharge is liable to bring up sand with water; call it ‘D’]

3. **Rate of percolation:**—This depends upon the nature of strata in which the strainers are located and is expressed in gallons per hour per square foot of strainer area, per foot of depression; call it ‘P’. Closely packed fine sand offers greater resistance to flow than loose coarse sand; therefore, this figure varies considerably with different strata. The experiments carried out in the Punjab by Mr. D.A. Howell, formerly Chief Engineer, Public Health Department, indicate that the discharge varies from 8 to 30 gallons per hour but may be taken as 15 gallons for fairly good sand. Discharge in gallons per hour from a tubewell may then be taken as $A \times D \times P$.

Location of strainer:—The strainers are located in medium and coarse sand as these have better permeability than fine sand, silt or clay. A weighed quantity of sand without *kankers* is taken and passed through sieves having different slot widths. The retention of sand on sieve, which is given vibratory motion for a minute, is noted by weighment.

The following specifications are adopted to classify sands.

10% or less retention on sieve No. 4	...	Very fine
10% retention on sieve No. 6 to 8	...	Fine sand
10% " " " No. 10	...	Medium sand
10% " " " No. 12 to 13	...	Coarse sand

NOTE :—By No. 4 sieve is meant sieve having slot width of $4/1,000''$.

To ensure that the sample obtained is not from a small local belt in the stratum, the morning and evening water levels in the bore are also recorded twice a day. This gives an indication of the recuperation of water levels in the bores and the nature of the stratum at the bottom of the casing pipe. If a tubewell is to be used for direct irrigation then its water should be analysed to see whether it is fit for irrigation. Such a test must include the determination of PH value, conductivity, salt index, quantity of salts and the total solids present in the water.

Length of strainer : It has been observed that the discharge of a well is not directly proportional to the length of strainer. A definite length of strainer is required to give a particular discharge and any length over this will not improve the discharge. For a two cusecs discharge, the length of $7\frac{1}{2}''$ strainer should not be more than 125 ft, subject to a tolerance of 50%. Smaller lengths of strainers are more efficient, as they cause more effective pressure deficiency in the various strata surrounding the strainer.

Type of strainers : Brass strainers with oblique, horizontal or vertical slots of Cook's design are quite suitable for Punjab soils, but they are very expensive. Strainers made from ordinary M.S. sheets and sprayed both inside and outside with speltre should give satisfactory service and are worth trying.

“[*Siting of tubewells*. In order to find the most effective and economical distance the following experiments were carried out in the Irrigation Research Institute, Lahore.

(1) Sand tank model experiments (2) Three and two dimensional electrical analogy experiments.

These experiments proved that :—

- (1) The contribution from canal seems to attain a constant-value after 600 feet from canal for a strainer length of 250 ft., under the same condition of depression head.
- (2) The seepage of canal, however, varied between 1.75 experimental units and 4.25 experimental units at the two positions. Evidently, the seepage from canal with well at 100 ft. away was 72% of total tubewell discharge as compared to 26.7% at 600 ft. Constant-value of discharge was obtained when the well was beyond 700 ft.

By extrapolating the discharge and canal seepage curve in sand tank method, the following values were obtained :—

Distance of well from canal	Discharge of well	Seepage from Canal	Contribution from water-table.
600	4.85	1.75	3.1
500	4.95	2.00	2.95
100	5.68	4.25	1.43
50	5.9	5.0	—

At 50 ft., the contribution of canal seems to be $\frac{5.0 \times 100}{5.9} = 84.6\%$, and at 600 ft., it is reduced to $\frac{1.75 \times 100}{4.83} = 26.7\%$; thus, reduction of 57.9% takes place.

This result is also confirmed by both two and three dimensional electrical analogy experiments ; although there is a variation to the value, due to the different method of experimentation.

Further, it was established from these experiments that :—

- (1) In the existing position alongside the canal, wells are taking major portion of their discharge from the canal and this supply will continue to increase with lowering of S.S.W.L.
- (2) Shifting the position of wells 700 ft. away will reduce the canal seepage by at least 55% so long as the general lowering of S.S.W.L. does not take place, in which case the seepage will increase according to the established laws. The cone of free surface to a well is very steep.]”

Experiments carried out in U.P., by Dr. Mackenize Taylor indicated that the radius of influence of $1\frac{1}{2}$ cusecs tubewell was about 1,000 ft. in the average soil. This is an ideal distance for siting the tubewells but the cost of earth-work involved in shifting the wells to this distance was so prohibitive that it was decided to install further wells at a distance of 600 ft. from the canal. Even at this distance i.e., 600. ft., the cost of the project would be increased by more than Rs. one crore. The writer is in perfect accord with the proposed distance, but is of the opinion that the arrangement of the wells requires some modification and suggests that out of the five tubewells in each group three should be placed in the front row and two in the back row.

The tubewells in the first row may have strainers located even in fine sand. The strainer slots should, of course, agree with the size of the sand comprising the strata. The depth, of the tubewell should preferably be 150 ft. or upto a clay

layer (of sufficient depth, say 20 ft.). The strainer length may not be more than 100 ft.

The tubewells in the second row should be sunk to the usual depth of 250 ft. to 300 ft., so as to give two cusecs discharge with the strainer length of about 125 ft. The strainer should be located in medium or coarse sand only, but in this case the strainer may not be put in the first 80 to 100 ft.

The idea of placing two tubewells in the back row is to employ them for extraction of water from the sub-soil alone. The three tubewells in the first row will draw their supply partly from the canal and partly from the sub-soil, whereas the other two tubewells will not draw their supply from the canal, as they will be shielded by the first row of tubewells. The line of gradient emanating from the canal will end in the first row of the tubewells, thus the tubewells at the back will draw their supply from the sub-soil water.

The interference between working of tubewells in the first row will be about 6.4% and in the second row about 13%, which cannot be avoided under the circumstances.

This arrangement is more effective than having a group of five tubewells in the first row, as in that case the seepage of the canal will be increased by about 27%. Moreover this arrangement will not involve any additional expenditure.

The writer thinks, that we should not have started the installation of tubewells without first carrying out trial bores over the area menaced by waterlogging. For this purpose, 4" trial boring, at a distance of half a mile or so, should have sufficed. Geological data thus obtained, could be utilized in preparing the strata charts for each canal. Having obtained this data it could then be decided whether tubewells are required for :—

- (1) De-waterlogging purposes.
- (2) Increasing the intensity of the existing canal.
- (3) Direct irrigation.

These are the three distinct categories under which the tubewells can be used. It may not be possible to employ them for the above three functions collectively. A perusal of the strata chart of the Upper Chenab Canal and Rakh Branch will show that waterlogging problem on these two canals would be solved if we control the water-table in the stratum above the clay layer. The clay being an impervious medium, it is no use carrying bores beyond this depth, unless it is required to have definitely two cusecs to increase the intensity of the canal. In such cases it may be necessary to have smaller capacity pumps, say $\frac{3}{4}$ to one cusecs, to deal with water in the strata above the clay layer. On account of low value of transmission-constant, the yield from fine and medium strata will be poor. To cope with seepage, the number of pumps can be suitably increased.

If the clay layer occurs at a distance of about 50 ft. from the ground surface, then the installation of tubewells may be dispensed with and shallow wells dug at suitable distances to deal with seepage.

Where clay belt is not present and the area is waterlogged, vide strata chart for Upper Jhelum Canal, there we unusually have a thick belt of fine sand. This is due to the fact that the rate of accretion due to seepage is more than that of run-off. In such cases our problem lies in the extraction of water from fine sand, and for this purpose, we need not take our tubewells too deep, but restrict the depth of the bore to the depth of the fine sand stratum, or at the most to medium sand stratum, if such stratum follows the fine sand stratum.

Another inference that can be drawn from these charts is that wherever the soil crust is very thin we might consider lining of the canal in that reach. On the other hand, where soil crust is very thick, the installation of tubewells in such reaches may be dispensed with. Thus we see that there are quite a few advantages of having such a record.

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FOREST RESOURCES OF WEST PAKISTAN WITH PARTICULAR REFERENCE TO THE PANJAB

By

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Since colonization began in the Panjab, Bahawalpur and Sind, old *rakhs* have gradually been colonized and fuel supplies have been decreasing. A stage has reached when fuel shortage has become a major problem. The large increase of population since 1900 has made the position worse.

Large areas of civil *rakhs* were placed in the charge of Deputy Commissioners with the object of supplying fuel and grazing for the local population. For want of expert knowledge and proper control all tree growth from such civil *rakhs* has by now disappeared.

Villagers have cut and sold large quantities of firewood from their waste lands during the war. Firewood is selling at exorbitant prices in the towns. The outturn of firewood from Government forests is only a small fraction of the total requirements of the country.

The destruction of tree growth and consequent soil denudation has resulted in washing down of the top soil and its fertility. In the Salt Range (Jhelum district) it has exposed layers of salt which is now being washed down with rains and making land in the plain saline on a large scale. Large number of wells have turned brackish in the foothills. Lack of tree cover has reduced soil moisture and in consequence fodder grasses have decreased rapidly.

Land and water resources are the main source of a country's wealth. Right utilization and conservation of land and water resource is essential.

Production of firewood in rural areas is necessary to release the farm yard manure for crops. Large increase in the number of trees in the country will make for better climate, more rainfall, and fertility of land as leaf-fall adds organic matter to soil.

All State and private lands must be put to proper use. Best lands should go under cultivation and marginal lands now lying waste must go under trees.

The aim should be to grow trees on all lands, public and private, which are not used otherwise, including District Boards, P. W. D. Roads, Canal banks, Railway lines, Camping grounds, Fair grounds etc., in fact any lands which cannot be used otherwise. A mass drive on national scale is essential to attain this end.

PRESENT POSITION OF FIREWOOD SUPPLIES

Panjab :

The total consumption of firewood in the Panjab for towns over 20,000 in population was estimated at 83 lakh mds. As the Forest Department only produces 22 lakh mds., the balance of 61 lakh mds., comes partly from waste lands and was met partly by imports from Sind and other sources. Villages and small towns make up their requirements of fuel mainly from cow-dung and agricultural by-products such as cotton sticks, stalks of maize and millets, and to a very small extent from firewood produced in waste lands.

Sind:

Sind has limited areas under forests mainly situated on the Indus. Irrigated plantations are being formed but the speed is nothing as compared with the rapid increase of population. Fuel prices in Sind are about Rs. 1/- per maund. The surplus of firewood from Sind has been marked down for Baluchistan. Some tree growth is found on canal irrigated lands but it is not enough to meet the increasing requirements of the country.

Baluchistan :

The nomadic tribes pasturing sheep, goats and camels have devastated all tree growth. Any visitor flying over Baluchistan could see the treeless waste that Baluchistan is. The little grass and bushes wherever they remain are being devoured rapidly, and the denuded top soil is rapidly being washed down, thus making the country infertile. The low rainfall in this tract makes it difficult for vegetation to keep pace with destruction (bare hills of Quetta are a clear indication to any visitor to this part the country). The tribal constitution of the population makes it extremely difficult of to enforce any control by way of rotational closures. The value of soil cover is not understood by the ordinary inhabitant.

Bahawalpur :

Bahawalpur used to send surplus firewood to the Panjab. This has ceased as a result of rapid colonization, and now Bahawalpur State cannot produce enough firewood to meet even its own requirements.

N.-W. F. Province :

The position of firewood supplies here is pretty bad. The tribal areas are left with little or no firewood as the nomadic tribes dependent upon pasturing cattle have destroyed whatever little soft-wood vegetation there was. They do not understand the implications of destruction of soil cover.

TIMBER SUPPLIES

Panjab :

Panjab produces a small quantity of soft woods, mainly *chil* and a little *kail*, in Rawalpindi district. The outturn is hardly enough for Rawalpindi, Jhelum

and Attock districts. The rest of the Panjab depends on supplies coming from Kashmir by rivers. It is therefore imperative that we should produce building timber (hard wood) in large quantities in addition to firewood.

Sind :

Sind produces little timber of any importance. Some timber is brought by sea from India and East Pakistan but its import is expensive on account of long sea and overland routes.

Soft-wood requirements are met from the Panjab timber depots mainly fed from Kashmir. Some *shisham* is also imported from the Panjab.

Baluchistan :

There is no timber worth the name in Baluchistan except very poor forests of *Chilgoza* Pine and Pencil cedar. The timber requirements of Baluchistan are also met from the same source as for Sind.

Bahawalpur :

There is no timber grown in Bahawalpur. The State has started small irrigated *shisham* plantations and the colonists are growing some on their lands.

N.-W. F. Province :

The only timber producing forests here are situated in Hazara district, but their supplies are limited. Some of this timber finds its way to Jhelum by river, from where it is exported along with the Kashmir soft-woods to Bahawalpur, Sind and Baluchistan. There are fairly good softwood forests in Dir, Swat and Chitral, but on account of tribal jealousies and lack of secure river transport they are not being worked.

West Pakistan for its soft-wood building timber requirements, will have to depend mainly upon supplies from Kashmir, supplemented by meagre supplies of soft-woods from the Frontier States.

AREA UNDER FORESTS

As judged from Western standards 20% of the total area of any country must be under forests. The percentage of forest area in the various Provinces of West Pakistan is given below :

	per cent	
1. N.-W. F. P.	... 2.1	} Annual Returns of statistics relating to Administration in British India for the year 1939-40.
2. Sind	... 2.4	
3. Baluchistan (British)	... 4.2	
4. Panjab	... 2.6	

On partition, Panjab received only 28% against 72% of the forest area which went to the East Panjab.

It is evident that we are deplorably short of forest wealth in West Pakistan. East Pakistan has 9% of the total area under forests and is comparatively better provided with forest wealth.

PROPOSALS TO MEET SHORTAGE IN THE PANJAB

We are so short of fuel that unless Government gives first priority to the production of firewood in its future programme, the position will worsen with dwindling waste lands under pressure of growing population. The problem of meeting the firewood supplies of the Panjab can be split into two parts :

(a) Rural areas.

(b) Towns.

(a) The purchasing power of the average rural family is low and it cannot buy fuel at high prices. Fuel cannot bear cost of long transports and therefore it must be grown locally in village lands.

(b) The firewood required in the towns should be grown in State forests well distributed over the country and situated near the towns. Unfortunately land is not always available where required. Under the circumstances we must do the next best thing and grow forests wherever land is available.

Consumption of firewood per capita

The Board of Economic Enquiry estimated the consumption of firewood in urban areas, excluding charcoal, coke and coal, at 5 maunds per head per annum, and 1 maund per annum for rural areas. This may be raised to 6 maunds for urban areas to include charcoal and to exclude coke and coal supplies.

Urban requirements

Total requirements of firewood at 6 maunds per head per annum will be 12 million maunds for urban population. It is proposed to meet the whole of this demand from State forests.

The estimated outturn from area already available will be ;

	Area	Yield per acre per annum	Total estimated outturn
(a) Irrigated Plantation			
(i) Areas now bearing	45,556=.045 million acres	53 mds.	2.4 million mds.
(ii) Areas now being afforest- ed when in full bearing (Burala, Shorkot, Wan- bhachran, etc.)	30,000 } }=.0335 3,500 } million acres	50 "	1.7 " "
(b) Other forest areas (Scrub)	80,000=.08 million acres	4 "	.32 " "
Total outturn from State lands ...			4.42 million mds.

Total requirements of firewood	2 million souls × 6 mds.=12 million mds.
Deficit for urban areas only	7.58 million mds.

It is proposed to meet this deficit of about 7.5 million maunds as below :—

	Area Acres in millions	Yield per acre per annum	Total estimated outturn.
New areas required for irrigated plantations	.05	50 mds.	2.5 million mds.
Areas under tree owning Departments (District Boards, P.W.D., B.&R. and Irrigation Branch, etc.)	.10		3 ..
Civil <i>Rakhs</i> already transferred and being planted up	.70	2 to 10 mds.	2 ..
Total ...	.85		7.5 million mds.

In all future schemes of colonization grant of land and water for afforestation must be given first place.

Requirement of fuel for rural population

The requirement of firewood for the rural areas was estimated by the Board of Economic Enquiry at one maund per head per annum on the assumption that the villagers use very little firewood and their requirements are mainly met from cow-dung and agricultural waste products.

Certain by-products of agriculture will always be used as firewood in some districts but now cow-dung must go to enrich the soil. After allowing for the agricultural by-products other than cow-dung, the requirement of the rural population is estimated at 3 maunds per head per annum.

Waste lands

Out of 36 million acres of land in the Panjab, one half is under cultivation and the rest is waste land including 1.3 million acres of forest areas. The following statement is illuminative :

Class.	Present distribution
1. Net area cultivated	16.5 } 18.6 million acres
2. Current Fallows	2.1 }
3. Other uncultivated area excluding current fallows	10.4 } 17.1
4. Not available for cultivation	6.7 }
5. Forest	1.3
Total ...	37.0 Million acres.

17 million acres of waste lands may be analysed as below :

Class.				Present distribution		
1.	Culturable waste lands	...	...	3	million	acres
2.	Civil <i>Rakhs</i>	...	...	2	"	"
3.	Entirely unproductive	...	...	4	"	"
4.	Private and Crown waste lands	...	...	8	"	"
Total				17	"	"

Of the 8 million acres of Private and Crown waste lands 5 million acres may be taken as private owned waste lands available for afforestation. This is estimated to yield 40 million maunds when afforested.

Land owners must grow 4 trees per acre on all cultivated lands

A certain number of trees are always grown at the edge of the fields. They form a valuable source of supply of firewood and timber to the owners. It is essential that every owner of agricultural land be required to grow at least 4 trees per acre in the fields or on the sides of water channel. They serve as wind breaks and protect crops from hot winds. Twenty million acres (area under cultivation 18.6 million acres plus 1.4 million acres cultivated waste) under agriculture will produce 80 million trees. This is equivalent to .64 million acres of forest. It will yield about 16 million maunds per annum of firewood and forms the second major source of production for rural areas.

The rural demand for 60 million maunds will be met as below :

				Area million acres	Yield per acre maunds	Outturn million maunds
Civil <i>Rakhs</i> (Part)	...	...	...	1.05	2 to 10	3
Private waste lands	...	...	...	5	10	40
Cultivated land at 4 trees per acre (reduced area)				.64	20 to 30	16.6
				6.69		59.6

Total area thus afforested to meet urban and rural requirements will be 7.69 million acres which represents 20.7% of the total area of Panjab. The entire estimated outturn from all sources will be available after about 20 years but there will be an appreciable increase of supplies in 5 to 10 years.

On similar basis fuel requirements of other Provinces in West Pakistan could be worked out.

Village Forest Act

In order to enforce growing of trees on waste and agricultural lands a Village Forest Act is essential. The Act should require all owners to form Societies or Village Committees for planting on voluntary basis. If they are not able to do so they should lease their land to the State or hand over control voluntarily. If they fail to do either, the Government should take over management for a period of 20 to 30 years. When Government takes over management, rights in the property will remain intact. Only the exercise of rights will be regulated.

Organization to enforce the Act

The Act should be enforced sympathetically. This can be done by reducing official interference to the minimum. A provincial Afforestation Authority will administer the Act under which there will be District and Tehsil Afforestation Authorities under which Village Afforestation Committees will function. All the above authorities will be assisted by Forest Officers in the capacity of Secretaries. The Village organization administering the act will be a Panchayat, a Forest Society or a Village Afforestation Committee. Committees may be formed from 3 to 4 adjoining villages for greater impartiality. If a Committee constantly ignores its responsibilities, the management must be placed under the Forest Department for a number of years. The function of these bodies will primarily be the afforestation of waste lands, planting trees in cultivated lands, control of grazing, improvement of pasture lands, development of cottage industries, using forest produce to provide employment for the growing population. The aim will be to complete planting of waste land in 10 years, but planting of trees in agricultural lands must be completed within 3 years. Considering the vagaries of rainfall, on which a great deal of the work will depend in *Barani* lands, 10 years is not a long period. Planting over bigger areas will alone extend to a maximum period of 20 years.

Financing the planting operations

To plant large areas of waste lands for the rural communities very large sums will be required. This can be met as below :

- (a) By levying a cess on all waste lands to meet the cost of staff.
- (b) The cost of planting can be given in the form of loans and recovered from the owners in easy instalments. Planting costs can also be recovered from sale of forest produce.

Grazing versus Closures

In order to grow trees it is essential to close the area against grazing until the trees have grown above damage by cattle. Closures will only be necessary for a short period till the crops are established. In any case, closures will present no serious difficulty as they can be rotated,

Protection against browsers

Protection is a very important matter in forestry. Considerable damage is done to tree growth by herds of goats. Goats are said to have destroyed civilizations and they have already done tremendous damage to this country. No owner can grow trees because of the herds of goats. These herds must go. No goat-herd should be allowed to roam in the country-side. Sheep is comparatively less harmful and can satisfy the meat requirements. The movement of herds of camels must also be restricted.

Owners versus occupancy tenants

There have been great differences between the owners and the occupancy tenants in the past. The closure always helped the owners but left occupancy tenants helpless. It should be provided in the Act that when an area is opened, the tenant should have the right to cut grass to the extent of his bona fide requirements.

Exchange of areas under forests

Large scale leaf fall adds much needed organic matter to the soil. Primitive man burnt the forest and cultivated the land. When the soil was exhausted he left the area and repeated the same process elsewhere. Natural forest appeared again, and fertilized the soil with organic matter when it was again brought under plough. This is how soil is fertilized and rejuvenated in nature.

When an area is fertilized and rejuvenated by tree growth the owners will prefer to grow crops thereon. This can be allowed.

Release of forests

It is not intended to keep control of forests under official agencies for ever. Forest Department control can be withdrawn on the owner giving an undertaking that management will be carried out under the general guidance of the Forest Department.

Planting on river sides

Recurring flood damage during years of heavy rainfall is a standing menace on some rivers. This can be avoided by planting belts of trees on both banks of the rivers. This would raise the bank and protect the countryside.

Shelter belts in Thal

Success of the Thal project depends entirely upon the planting of shelter belts. Large scale tree planting in Thal is essential.

Planting and seed collection weeks

A great deal can be done by organization of planting weeks under non-official agencies. Collection of seeds can be arranged by inaugurating seed weeks in schools. The Forest Department will also arrange for the supply of seeds and plants.

If the country realizes the full significance of the problem it can produce all its fuel and timber requirements within West Pakistan.

PRESENT INADEQUACY OF FUEL AND POWER RESOURCES AND THEIR DEVELOPMENT IN EAST PAKISTAN

By

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Economic Consequence of Partition and its effect on Fuel and Power position

The partition of Bengal was done on the most disadvantageous basis for East Pakistan. It robbed the province of all major industries, specially jute manufacturing, chemical and engineering works; of electric power facilities and fuel sources. The partition reduced the province to an entirely agricultural and raw material producing area. Having lost coal and other fuel resources to West Bengal, East Pakistan was further deprived of major hydro-electric power sites in the province. After the partition only *one* hydro-electric project of a limited power can be developed in East Bengal.

Port of Calcutta, among the largest ports in Asia, also remained in West Bengal. East Pakistan's *only* port, Chittagong, has a limited capacity and will involve huge capital expenditures to increase its capacity to handle all its sea-borne trade. A large mileage of railways and roads also remained in West Bengal. East Bengal would have to undergo heavy capital expenditures in improving its transport and communications, and building its power plants, and to pay constantly a large fuel bill to alien suppliers.

Under the partition scheme, East Bengal received about two-thirds of land area and population of undivided Bengal. This represented over 95 per cent of rural population living in some fifty thousand villages. East Pakistan is without fuel resources, and what little power exists, is being generated from imported coal and oil at a high cost and supplies of which are often interrupted and delayed.

While potentially rich in several resources for industrial development, particularly jute, hides and skins, tobacco, tea, paper pulp and sugarcane, East Pakistan, comprising an area of about 50,000 square miles, is heavily dependent on agricultural economy to support a population of over 47 million, which is increasing at the rate of about one million per annum. The density of population averages over 800 persons per square mile, probably heading the list of thickly populated areas of the world. The pressure on the land is also such that an average agriculturist has only half an acre of land from which to eke out a bare existence.

Therefore, the need for developing industries to balance agriculture, and to relieve pressure of population on land which is forcing the standard of living lower and lower, is not only obvious but urgent. For the development of industries the greatest need is adequate fuel resources and dependable supplies.

The long distance separating West Pakistan from East Pakistan limits haring of fuel and power resources located in the western part.

Inadequacy of fuel and power resources in East Pakistan warrants at least a feeling of restrained optimism in the initial stages of industrial development.

1. FUEL

1. Present Position—Inadequate Supplies

After the partition, the province suffered very much from frequent interruptions and delays in the flow of fuel supplies coming from India. The most critical shortage from the outset has been that of coal. Out of our total requirements for railways, inland shipping, industries, power plants and domestic consumption, estimated at over 2 million tons a year, we received less than 1.3 million tons. Furthermore, rising cost of coal and oil added to the fuel expenditures of manufacturers and services.

At times the situation became critical. In order to keep going Dacca water supply, 500 tons of coal had to be seized from the stock pile of a local glass factory, which in turn had to close down. Railway transportation was adversely affected not only for lack of coal, but coal wagons of which there was an acute shortage; and those sent to India to fetch coal were held up sometimes for months. To keep essential industries operating, the railway at one time had to hand over 5,000 tons of its coal for distribution among factories. Fuel oil supplies were similarly curtailed by shortage of tank cars, and by reduced train schedules of railways. It is reported that it takes more than two weeks to make a round trip for a tank car from Chittagong to Dacca and back.

There is no denying that inadequate fuel supplies have seriously affected the industrial expansion and transportation.

Therefore, fuel situation in East Pakistan, more than ever, requires a serious consideration.

The principal fuels used in the province are coal, furnace oil, motor petrol, aviation petrol, wood, paddy husk, bagasse, jute sticks, etc. etc. Also, a large quantity of kerosene is used to light small lamps in seven million homes and huts. The major consumers of fuel in East Pakistan are :—

- Industrial and manufacturing establishments,
- Railway and steamship lines,
- Electric power plants,
- Motor cars and public vehicles,
- Commercial air planes,
- Domestic consumers.

Many factories use various kinds of substitutes for coal in their boilers. More than 75 per cent of rice mills use husk, sugar mills—bagasse, tea factories—wood, and saw mills—sawdust. These by-products fill a big gap in the fuel supplies of the province.

Estimates of present requirements and supplies of fuel are given below :—

	Present Requirements	Present Supplies	Deficiency.
Coal, including soft, hard and coke	2.3 million tons	1.3 million tons	1.0 million tons
Furance and Diesel fuel oil ...	25,000 tons	25,000 tons	No deficiency
Petrol for motor vehicles ...	4 million gall.	3 million gall.	1 million gall.
Aviation petrol ...	350,000 gall.	350,000 gall.	No deficiency
Kerosene ...	140,000 tons	110,000 tons	30,000 tons

No estimates of indigenous fuel, such as paddy husk, bagasse, jute sticks, etc. can be made. All that may be said is that whatever supplies are available are utilized in villages locally, and very little is sent out and merits no weight in considering fuels for industries.

2. Coal

For coal we have to depend principally upon India. The cloudy political atmosphere of last year had much to do with the coal shortage in East Pakistan. In order to ensure reasonable supplies, we must explore other sources of coal and also to improve the utilization of fuel. India's own requirements of coal are going to be more than doubled, while her proven reserves of high grade coal are limited. Already in India, emphasis is being laid on coal conservation and effective utilization.

Particularly during the past 25 years, the subject of coal and other fuels has been given much publicity in all the leading industrialized countries, and a great deal has been done towards solving the 'coal or fuel problem,' as its importance has been increasingly realized.

One of the factors which has affected the demand for coal all over the world is the increasing tendency of consumers to use other fuels, such as furnace oil. The conversion of coal-fired boilers in industries and power plants, could reduce coal demand in East Pakistan by half a million tons per annum. It can be said that one pound of oil may be substituted for 2.5 pounds of coal. Also the easiness with which liquid fuel can be transported and handled, has led to the preference of oil over coal.

Supplies of coal to railways and industries have been uncertain and frequent closures of factories have resulted in huge losses in output, and break in essential services. It is important to arrange for fuel supplies that will not be liable to periodic interruption. Before the war, India used to import coal from the United Kingdom, South Africa, and other countries. With favourable trade balance, Pakistan should also be able to augment its supplies of coal from abroad,

In order to insure a reasonable supply, many important problems have to be solved.

(i) A considerable proportion of coal for East Pakistan comes from Bengal and Bihar coal fields, and it is desirable that transport capacity be expanded and improved, and agreement be reached with India for guaranteed supply of coal from her.

(ii) There is a necessity of a controlling agency to regulate the distribution of stocks commensurate with the needs of various consumers.

(iii) There is need for research to improve the utilization of fuel and to reduce consumption of coal per unit of energy. As an example, it may be mentioned that electric power plants using low-pressure boilers require 2.5 to 3.0 pounds of coal for each Kwhr. generated. But in an efficient and modern power station using high pressure and super-heaters, consumption of coal could be reduced to 1.5 pounds per Kwhr. It is true that initial expenditures in modern plants are high, but the savings in fuel in the long run prove them to be cheaper. In Pakistan, where we have an acute shortage of fuel, we can ill afford to waste coal which we have to import.

As the future demand for fuel in the province is tending to increase rapidly these factors assume greater importance in industrial development and planning.

3. Fuel Oil

Our supplies of fuel oils are mostly obtained from the Persian Gulf area. Burma was never a considerable producer of fuel oil and it will be a long time before Indonesia is again likely to be in a position to resume supplies. Oil is a pawn in international politics, and it is only prudent not to depend heavily for oil needs on foreign sources. Both East and West Pakistan are reported to contain oil reserves, and national interest demands that these resources be explored quickly and exploited intensively.

On the basis of price of coal and oil per ton, and per B.T.O., oil is costlier than coal. Higher cost of oil is due to import and other duties, and high freight charges. In view of inherent advantage in popularizing oil fuel in Pakistan, the question of duty and other levies, and freight rates on fuel oil should be re-examined. Fuel cost has become a significant factor in the total cost of production. To encourage rapid and vast industrialization it becomes all the more important to provide cheaper fuel. Various levies on fuel oils account for half the price of the fuel which the consumer pays. Duty on oil has followed the idea of protecting coal industry. Pakistan has no coal industry to protect, on the other hand it is vitally interested in the development of its major industries requiring cheap fuel.

Fuel prices have been steadily rising since 1939. Coal (Jharia Selected A grade) which was selling at Rs. 4/8 in 1940, had increased in price to Rs. 16/13 per ton by 1947 in India. Prices of coal at Chittagong and Dacca are now quoted above

Rs. 36 per ton. Diesel oil prices in East Pakistan have risen from Rs. 55/- per ton in 1939 to Rs. 150/- per ton in 1948, and furnace oil prices from Rs. 41/8 per ton in 1939 to Rs. 100/10/- per ton in 1948.

Shortage and undependable supplies of fuel, coupled with rising prices, and on the other hand need for conserving and effecting utilization of fuel have placed an increased importance on development of central electric stations. The idea is attractive as it is likely to result in economy of fuel consumption, because of the greater efficiency of fuel in large power generating plants.

4. Future Requirements of fuel in East Pakistan

Any estimate of fuel requirements for a long period beyond five or ten years must necessarily be unreal. The position is rendered more difficult in view of the fact that we cannot know what new consumers of fuel may come into existence in the distant future and what are likely to be their requirements.

The vast industrialization programme that is envisaged in the province, indicates that fuel requirements during the period of next five years are going to be three times the present consumption.

The railway department is adding new lines, and to bring its service to a respectable level of efficiency, it will have to more than double its locomotives. Present consumption of railways of 500,000 tons annually will rise to more than 1.2 million tons.

Cotton textile industry on the average requires 0.8 tons of coal per spindle annually. If the capacity of the industry is to be increased by 50 per cent, it will necessitate 50,000 tons of additional coal each year. Proposed jute mills and allied industries would require equally the same amount of fuel. Installation of new thermal plants would increase the present requirements of fuel by eight to ten times for electric power companies. Paper mills on the average require 2.5 tons of coal per ton of paper. A 30,000 ton capacity mill would need 75,000 tons of coal or substitute fuel. A part of these fuel requirements are expected to be met by hydro-power.

Other miscellaneous industries, which now consume over 300,000 tons of coal annually, will require additional fuel amounting to 100,000 tons to meet their expansion. Also, new industries to be established in the course of the next five years are estimated to require no less than 500,000 tons of coal. Total fuel requirements for industries, railways and steamers, and electric power plants, are estimated to aggregate over 5 million tons in terms of coal and over 2 million tons in terms of fuel oil.

Demand for petrol for motor vehicles is estimated to increase by 50 per cent, requiring six million gallons annually.

Present carrying capacity of the railways is totally inadequate to carry all fuel required by the province. Besides taking steps to increase the railway capacity, supplementary means such as river tankers and barges would have to be employed to move fuel from ports to inland consuming centres.

The fuel problem in East Pakistan is of great national importance and on its solution rests the realization of industrial programme.

II. POWER

All Power Facilities Remained in West Bengal

The division of Bengal made East Pakistan totally bankrupt of its electrical power supply resources and potential hydro-electric power. Of the total electric power installed capacity in undivided Bengal, less than three per cent is located in East Bengal. On the basis of electric output, it makes a still poorer comparison. Total Kwhrs. generated in East Bengal account for only one per cent of energy produced in the undivided province. In addition, all major sources of hydro-electric power, Gumti, Teesta, Jaldhoka and others, with the exception of a moderate power possibility of Karanafuli, went to West Bengal.

1. Present Position

Total present installed capacity of all electric power plants in East Pakistan is estimated at 15,600 Kw., which is less than the capacity installed to supply the city of Lahore. This represents the lowest power capacity in the whole sub-continent of Indo-Pakistan.

The installed capacity is distributed as follows :—

(1947)

In Electric Supply Power Plants (Seventeen Stations)

Oil Engines	...	...	3,332	Kw.
Steam Engines	...	...	200	„
Steam Turbine	...	...	3,000	„
Total			...	6,532 Kw.
In Cotton Mills at Narayanganj	...	...	...	4,380 „
East Bengal Railway Plants	...	...	...	3,650 „
Other Industrial Plants (estimate)	...	...	...	1,000 „
Total			...	15,562 Kw.

Most of the electric power plants are of relatively small size ranging between 200 and 500 Kw. capacities using Diesel engines. The biggest electric supply plant of 3,000 Kw. steam turbines is at Dacca. Despite the war-time conditions, under which it was difficult to obtain power machinery, total installed capacity in electric supply plants increased from 3,972 Kw. in 1939 to 6,532 Kw. in 1947.

In addition to power plants operated by electric supply companies, East Bengal Railway owns two steam turbine plants, one at Chittagong of 2000 Kw. capacity, and the other at Saidpur of 1,650 Kw. capacity. The plant at Chittagong also supplies bulk power to a local distributing company. At Narayanganj

Dhakeswari Cotton Mills have the biggest privately owned steam power plant in the province with a capacity of 4,380 Kw.

Present electric power capacity of the province on the basis of Kw. is equally divided between steam and Diesel plants, but nearly two-thirds of the output is generated in Diesel engine stations.

At present of the 58 towns (with a population of over 5,000) in East Pakistan, only eighteen towns are serviced with electric power. Almost all towns with a population of over 30,000 have electric plants. Six towns whose population ranges from 10,000 to 20,000 have also their own electric plants.

Of the total population of 4.7 crores in the province, the estimated population living in areas served with electricity is only about 8.5 lakhs, or less than two per cent.

Use of electricity in the province continues to be restricted, but is steadily increasing in recent years. Kwhrs. generated in 1939 have doubled in 1947. In 1939, output in all electric supply companies in the province totalled 5.6 million kwhrs. by 1945 it rose to 10.7 million kwhrs, and in 1947 to 11.6 million kwhrs. The annual rate of increase has been about 15 per cent.

Kwhrs. generated annually, per capita served, range from 17 in Dacca to 2 in Bhairab Bazar, which has the smallest power plant (15 Kw.) in the province.

Kwhrs. sales among various classes of customers are well distributed. Domestic consumers (light and fans) account for 40 per cent of total sales; commercial consumers (light and small power) 16 per cent; industrial and large consumers 32 per cent; street lighting 8 per cent; water works and other consumers 4 per cent. These diversified sales have enabled companies to improve their load factors, specially in cities where new industrial load is increasing. Kwhrs. sales per customer vary from 166 to 943 and the average is below 500 Kwhrs. annually.

Total number of consumers in the province is estimated at 16,000 or 20 customers per 1,000 persons living in the electrically serviced area. Total revenues from the sale of electric power by electric supply companies in 1947 equalled Rs. 26.5 lakhs. Annual revenues per customer varied between Rs. 90 to Rs. 212, and the average is estimated around Rs. 150.

High fuel price is reflected in the high cost of Kwhrs. generated which has doubled since 1939, the pre-war year. Average cost in a Diesel plant is over four annas per unit and in a steam turbine plant it is two and a half annas. Average revenue per Kwhr. varies from four annas in a large system to eight annas in a small system.

2. Demand for power Increasing

During the last decade, sale of electric energy in the province increased at an annual rate of about 15 per cent. This rate of increase was during the war and pre-partition period, when industrial development of the province was centered

around Calcutta and other West Bengal districts. East Bengal being agricultural had no major industries to speak of. Now with the changed condition, demand for power and rate of increase in electric output is likely to be at a higher annual rate. Besides the rapid rate of increase in population so characteristic of Bengal, industrial development of East Pakistan is bound to have a pronounced effect in stimulating a high demand for electric power.

Preliminary estimates for the province indicate an increase of 30 per cent annually and in some areas as high as 50 per cent, provided fuel and additional service facilities become available.

In view of the sharp and steady rise in load during the past ten years, and inability to obtain adequate new power plant equipment during war years, surplus capacity in all supply systems has been rapidly diminishing. In some plants the maximum demand has already risen to the permissible operating capacity. Several plants have installed additional capacities, and some additions are under construction. Major addition is of 3,000 Kw. at Dacca, which will double the present capacity of the stations. In Dacca the growth of demand for electric power has been phenomenal due to its becoming the capital of East Pakistan.

The next five years are expected to see the inauguration of many major industrial units, specially jute, paper, and cotton textile mills, chemical plants and engineering works, besides scores of small and medium scale industries, important among them being tanneries, glass works, food processing, etc. etc.. It is estimated that these industries would require about 60,000 Kw. power. In addition, increased demand from existing industries would require another 25,000 Kw. capacity.

3. Planning for Electric Power Development

Under electric development studies sponsored by undivided Bengal, schemes for electricity in areas now forming East Pakistan covered development of several nursery systems, which were later on to be linked to district grids supplied by hydro-power situated in Assam, North Bengal, Tippera State and Damodar Valley Project. This was an ideal proposal, and in view of fuel shortage hydro supplies would have been most welcome for the development of the province. But in view of the bitter experience in the Panjab, and continuation of cloudy political atmosphere overhanging inter-dominion relations, it will be not only very prudent but necessary to revise earlier views and look at the development in a more realistic manner, and plan new schemes to meet changed economic, political and sociological conditions.

In earlier plans emphasis was laid for electricity development in areas which were to be covered by hydro-power, and most of the nursery schemes were tied to the broad and general plan of hydro-power transmission systems. Also, at that time no major industries, such as are conceived now, were visualized for East Pakistan. Therefore, a fundamental change in the concept of power development in the province has taken place,

It is now obvious that with the exception of Chittagong area, we have to rely upon thermal stations for our electric requirements. Under the old concept, industries would have to be localized where cheap hydro power would be available. Now, due to high cost of fuel and heavy dependence on thermal plants, centers of electric generation have to be located in the heart of areas where demand for power from industries and urban population would develop quickly. Due to loss of major hydro-electric sources, and the province being divided by thousands of rivers and *khals*, which inundate large areas in summer making communication and transportation by land almost impractical, it will not be possible to build up a province-wide grid system, specially fed by thermal power stations.

Efficiency of Diesel engines has narrowed down the difference between the cost of electricity produced in large steam central stations located far off from the load centres and medium size Diesel plants. In order to avoid economic and sociological evils of highly centralized concentrated urban and industrial areas, and to keep population well distributed and diversified, it will be desirable to spread out industries and power requirements. Local conditions in the province favour the development of medium size 1,000 Kw. diesel plants rather than building up of a few large steam plants.

For intensive electric development it is proposed to divide the province into five power districts. These districts are based on the natural division of the province by its major rivers, the Ganges, Brahmaputra, and the Meghna.

1. Northern district covering Dinajpur, Rangpur, Bogra, Rajshahi and Pabna.
2. Central district covering Mymensingh and Dacca.
3. Eastern district covering Kushtia, Jessore, Faridpur, Khulna and Bakarganj.
4. Chittagong district covering Chittagong, Chittagong Hill Tracts, Noakhali and Tippera.
5. Sylhet district.

In each district big urban centres, where industrial growth is likely to develop, will be selected for concentration of electric power generation to be inter-connected with surrounding and nearby towns by medium voltage lines. To develop loads, nursery schemes with Diesel plants are proposed to be introduced in and around such centres.

Initial nursery schemes proposed will be in the following areas :—

Around Noakhali, at Feni, Noakhali and Chowmahani; these are later to be linked to hydro-power in Chittagong district.

Around Mymensingh, at Jamalpur, Sherpur, Gouripur and Netrokana; to be linked with Central station at Mymensingh.

Around Bhairab Bazar, at Narsingdi.

Around Pabna, at Rajshahi and Rangpur.

In addition there are several other centres, such as Kishoreganj, Madaripur, Nawabganj, Dinajpur, Bogra, and Satkhira; all towns of over 20,000 population

holding possibilities of establishing Diesel plants forming the base for local grid systems.

4. Future Power Requirements

Subject to certain qualifications and limitations, future demand for electric power in the province after the next five years is estimated to be more than 100,000 Kw.

Power requirements of major industries to be established in the province are estimated as follows :—

New cotton mills and allied industries	...	15,000	Kw.
Jute and allied industries	...	30,000	„
Paper and allied products	...	5,000	„
Chemical industries	...	3,500	„
Tanneries, glass works, engineering workshops, etc.	...	3,000	„
Miscellaneous industries	...	5,000	„

Total ... 61,500 Kw.

It is estimated that the requirements of the province for electric power in five to seven years will be about 115,000 Kw. as compared with existing facilities of less than 16,000 Kw., necessitating an additional capacity of 100,000 Kw.

Approximately half of this capacity will be developed from hydro sources of the Karnafuli river and the other half from steam and Diesel power plants. Karnafuli hydro-electric scheme, while of important consideration in electricity development, is still distant. The earliest availability of power from this source is not expected until 1954. In the meantime it is proposed to install a thermal power station at Chittagong with an ultimate capacity of 20,000 Kw. to meet immediate need of power in that area.

Electric power capacity to be added in the province during the next five to seven years may be summarized as follows :—

	Present Capacity Kw.	Capacity to be added Kw.	Total Capacity Kw.
Existing generating stations of electric supply companies	6,532	15,000	21,532
Nursery developments	...	2,500	2,500
Electrification of new towns of over 20,000	...	5,000	5,000
Thermal Stations at Chittagong and Narayanganj	...	2,500	27,500
Total Thermal Capacity	...	9,032	50,000
Karnafuli Hydro power	...	50,000	50,000
Total Hydro and Thermal	...	9,032	100,000

Nearly seven times proposed increase in the existing capacity will not make the province any better supplied with electricity in relation to other provinces, as it will only provide two watts capacity per capita as compared to over 6 watts capacity that exists in other highly populated provinces. The West Bengal has now a capacity averaging 8 watts per capita and when new projects are completed, the capacity will increase by 50 per cent.

On the basis of Rs. 1,000/- per Kw., capital requirements for electricity development in the province will aggregate Rs. 10 crores. But this investment in relation to direct and indirect benefits that will accrue is not only small but essential for the security and prosperity of Pakistan.

PROCEEDINGS
OF THE
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KARACHI, 1950

PART I
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 Professor A. R. Nisser, c/o Grindlay & Co., Colombo, Ceylon.
 K. B., Dr. M. A. Haq, Inspector, Industrial Schools, Lahore.
 Khawaja Mubashir Hasan, Pb. College of Engineering and Technology, Lahore.
 Mian Nazir Ahmad Jiabaji, Superintending Engineer, Public Health, P. W. D.,
 Punjab Government, Lahore, (*Secretary*),

V. MEDICINE : VETERINARY SCIENCE, ZOOLOGY.

K. B., Dr. Muhammad Yusaf, 5, Durand Road, Lahore, (*President*).
 Colonel M. Jaffar, Director General of Health Services, Karachi.
 Colonel S. M. K. Mallick, Director of Health Services, Punjab, Lahore.
 Colonel M. Akram, Consultant Pathologist, G.H.Q. Rawalpindi.
 Colonel M. S. Shah, Chief Medical Officer, Government of Pakistan, Karachi.
 Mr. S. M. A. Shah, Director, Animal Husbandry, Punjab, Lahore.
 Mr. T. Ahmad Principal, Medical College, Dacca.
 K. B., Dr. M. A. Majid, 24, Purana Paltan, Ramna, Dacca.
 Dr. Hamid Khan Blatti, Zoology Department, Panjab University, Lahore.
 Dr. Riaz-i-Qadeer, K. E. Medical College, Lahore.
 Dr. M. Basir, Professor of Physiology, Dow Medical College, Karachi.
 Dr. M. Abdus Salam, Animal Husbandry Research Institute, Peshawar
 Dr. Nazir Ahmad, Deputy Director of Fisheries, East Pakistan, Comilla.
 Major S. M. K. Wasti, No. 1, Edward Road, Lahore.
 Dr. G. M. K. Baloch, Department of Medicine, K. E. Medical College, Lahore.
 Dr. Mushtaq Hasan, Dow Medical College, Karachi, (*Secretary*).

VI. PHYSICS: MATHEMATICS, STATISTICS ASTRONOMY, METEOROLOGY.

Dr. Abdul Haque, Professor of Physics, Engineering College, Dacca. (*President*).

Dr. Nazir Ahmad, Secretary, Development Board, Karachi.

Dr. M. Ishaque, 21, Cooper Road, Lahore.

Prof. J. M. Benade, F. C. College, Lahore.

Dr. K. J. Kabraji, Dy. Director, Central Engineering Authority, Karachi.

Mr. S. N. Naqvi, Director, Meteorological Centre, Lahore.

Ch. Abdur Rahim Khan, 8, Lawrence Road, Lahore.

Dr. R. M. Chaudhari, Government College, Lahore.

Dr. A. M. Mian, Panjab University, Lahore.

Dr. S. M. Mitra, Dean of the Faculty of Science, University of Dacca.

Mr. Muhammad Aslam, Director, Pakistan Meteorological Services, Karachi.

Dr. Nazir Ahmad, Physicist, Irrigation Research Laboratories, Lahore.

Prof. S. A. Hamid, Government College, Lahore.

Kazi Mutahar Husain, Lecturer in Mathematics, University of Dacca.

Dr. M. Zia-ud-Din, Head. Deptt. of Statistics, Pb. University, Lahore, (*Secretary*).

LIST OF DELEGATES

Egypt

Dr. M. R. Madwar Bey, Director, Royal Halewan Observatory, Halewan, Cairo.

Great Britain

Dr. Edward Hindle, General Secretary, British Association for the Advancement of Science, London.

Unesco

Prof. W. E. Purnell, Chief of the Division of Science Co-operation, Unesco, Paris.

Dr. Alexander Wolsky, Principal Scientific Officer & Director, Science Co-operation Office for South Asia, Unesco, Delhi.

East Pakistan

K.B. Fazlur Rahman, Director of Public Instruction, East Bengal.

Miss L. A. Baker, Inspectress of Schools, " "

Dr. S. Hidayetullah, Director of Agriculture, " "

Dr. Muhammad Amirul Islam, Agricultural Chemist, " "

Dr. Nazir Ahmad, Deputy Director of Fisheries, Comilla.

Mr. Abdul Haye, Regional Director, Pakistan Meteorological Service, Chittagong.

Dr. Abdul Haq, Professor of Physics, Engineering College, Dacca.

Dr. A.K.M. Abdul Wahid, Professor of Medicine, Dacca Medical College, "

Dr. M.O. Ghani, Head of the Department of Soil Sciences, Dacca University.

Mr. S.M.S. Zoha, " " " "

Mr. Nafis Ahmad, Head of the Department of Geography, " "

Dr. Kamaluddin Ahmad, Reader in Bio-chemistry, " "

Dr. Q. M. Hosain, Lecturer in Mathematics, " "

Dr. H.K. Yusufzai, Lecturer in Zoology, " "

Bahawalpur State

Dr. S. Zahir-ud-Din, Chief Veterinary and Livestock Officer, Bahawalpur Govt.

Dr. M. Shuja Namus, Vice Principal, S.E. College, Bahawalpur.

Mr. A. Majid, Head of the Department of Biology, S.E. College, "

Mr. A. Haq, Head of the Department of Mathematics, " "

Baluchistan.

Dr. H. Crookshank, Director, Geological Survey of Pakistan, Quetta.

Mr. Ali Sher Khan, Government College, "

Mr. A. A. Qureshi, " "

Dr. Amir Ahmad, Lytton Road, "

N.-W. F. P.

Dr. M. Abdussalam, o/i Pakistan Animal Husbandry Research Instt., Peshawar.

Mirza Anwar Beg, Chairman, Department of Chemistry, Islamia College, "

Mr. Faiz Muhammad Khan, Principal, Government College, Dera Ismail Khan.

Karachi

Dr. M. Rahimullah Qureshi,	Director of Fisheries.	Dundass Street,	Karachi.
Lieut. Commander S. H. A. Gardezi,	Naval Headquarters,		"
Lt. Col. J. Hughes,	C. M. H.		"
Mr. Irfanullah Khan,	o/i General Stores Laboratory,		"
Mr. M. A. Majeed,	Divisional Geologist, B.O.C. (Pakistan) Ltd.,		"
Mr. E. V. Corps,	Development Geologist,	" "	"
Mr. R. J. Hayman,	Senior Exploration Geologist,	" "	"
Mr. M. S. Hidayetullah,	C. Met. O.,	Air Headquarters,	"
Ch. Muhammad Afzal,	Director, Cotton Research, Pakistan,		"
Mr. Abdul Haye,	Pakistan Meteorological Department,		"
Mr. M. A. Latif,	"	" "	"
Mr. Jalil Tahir,	"	" "	"
Mr. Mazhar Umər,	"	" "	"
Mr. A. G. Khan,	"	" "	"
Dr. Yasin,	Dy. Animal Husbandry Commissioner,		"
Z. A. Hashmi,	Research Officer, Agri. Division, Govt. of Pakistan,		"
M. A. Khan,	Officer on Special Duty	" "	"

Sind

Mr. M. A. Zaidi,	Agricultural Research Station,	Sakrand.
Mr. Zainulabedin Munshi,	Asstt. Professor of Botany, Agri. College,	"
Syed Wahid-us-Saeed,	Government College,	Hyderabad.
Mr. Muhammad Nasir Raza Khan,	" "	"
Mr. Zafarul Islam,	" "	"

Punjab

Dr. A.G. Asghar,	Director, Land Reclamation,	Punjab, Lahore.
Dr. Shabbar Hasan,	Provincial Tuberculosis Officer,	" "
Mr. S. M. A. Shah,	Director, Animal Husbandry,	" "
Mr. F. R. M. Alvi,	Provincial Analyst, P.W.D.,	" "
Mian Nazir Ahmad Jiabaji,	Superintending Engineer, P.W.D.,	" "
Mr. I. A. Shah,	Chief Assayer, Pakistan Mint,	"
S. Irshad Husain,	S. D. O., P. W. D.,	"
Mr. Ali Ahmad Ismail Vohra,	Assistant Engineer, D. S. Office,	"
Mr. Sadiq M. Niaz,	Design Engineer, Irrigation Secretariat,	"
Dr. Nazir Ahmad,	Physicist, Irrigation Research Institute,	"
Mir Mushtaq Ahmad,	Hydraulic Officer, Irrigation Research Institute,	"
Mr. K. S. Hasan,	Divisional Mechanical Engineer, N.W.R.,	"
Mr. S. H. Nawab,	Divisional Electrical Engineer,	"
Mr. Abdul Karim,	Chemist and Metallurgist,	"
Mr. Jalal-ud-Din Qamar,	Steel Distribution Inspector,	"

Mr. Abdul Latif,	Deputy Inspector of Schools for Rural Science,	Lahore.
Mr. S. N. Naqvi,	Director, Regional Meteorological Centre,	"
Mr. A. G. Khan,	Regional Meteorological Centre,	"
Mr. Manzur-ud-Din,	" "	"
Dr. Kazi S. Ahmad,	Chairman, Department of Geography, Panjab University	"
Mr. Khalilullah Qureshi,	" " " "	"
Dr. M. I. D. Chughtai,	Panjab University Institute of Chemistry,	"
Dr. A. Kamal,	" " "	"
Mr. S. Warsi,	" " "	"
Mr. Muhammad Zafarullah,	" " "	"
Sh. Yusuf Ahmad,	" " "	"
Mr. Muhammad Salahuddin,	" " "	"
Mr. Abdul Majid,	" " "	"
Dr. Niaz Ahmad,	Director, Dept. of Chemical Technology, Pb. University,	"
Mr. Abdul Karim Qureshi,	" " " "	"
Mr. Riaz Ali Shah,	" " " "	"
Dr. Hamid Khan Bhatti,	Head of the Department of Zoology,	"
Dr. Muzaffar Ahmad,	Department of Zoology,	"
Dr. Zia-ud-Din,	Head, Department of Statistics,	"
Mr. Abdul Hameed Sheikh,	Lecturer, Botany Department,	"
Mr. Abdul Ghafoor Chowdhury,	Lecturer in Physics,	"
Prof. S.A. Hamid,	Department of Mathematics, Government College,	"
Mr. Lal Muhammad Chawala,	Deptt., of Mathematics,	"
Dr. R. H. Siddiqui,	Professor of Chemistry,	"
Dr. Chiragh Hasan,	Department of Chemistry,	"
Dr. Nazir Ahmad,	Zoology Department,	"
Mr. Ashfaq Ali Khan,	Senior Lecturer,	"
Dr. M. A. Pirzada,	K. E. Medical College,	"
Dr. G.M.K. Baloch,	" "	"
Major S. M. K. Wasti,	Mayo Hospital	"
Mr. Ikram Ilahi Chaudhuri,	Lecturer in Botany, F. C. College,	"
Mr. Riaz H. Khan,	Department of Geography,	"
Mr. Habibullah Khan,	Lecturer in Chemistry, T. I. College,	"
Ch. Muhammad Safdar,	Lecturer in Mathematics,	"
Prof. N.S. Japolsky,	Professor of Electrical Engineering, Engineering College,	"
Mr. B. A. Malik,	Assistant Professor, Engineering College,	"
Mr. A. R. Nasir,	Assistant Professor of Mathematics, Engineering College,	"
Miss Khalida H.N. Khan,	Dept. of Geography, Kinnaird College for Women,	"
Malik Amanat Khan,	Principal, Punjab Agricultural College,	Lyallpur.
Agha Ghias-ud-Din Ahmad,	Professor of Botany,	"

Lt. Commander Abdul Latif,	Prof. of Entomology,	Agricultural College,	Lyallpur.
Dr. Abdus Sattar,	Plant Pathologist,	"	"
K. S. Ch. Sardar Muhammad,	Agricultural Chemist,	"	"
Prof. R. C. Thomas,	Murray College,		Sialkot.
Mr. Abdul Hameed Sheikh,	Lecturer in Chemistry,	Emerson College,	Multan.
Mr. B. K. Mirza,	Assistant Superintendent of Industries,		"
Mr. S. A. A. Anvery,	Director, Pakistan Forest College,	Upper Topa,	Murree.
Mr. A. F. M. Alvi,	S. D. O. Canals,		Sargodha.

STUDENT DELEGATES

Mr. J. D. Shah,	Panjab University Institute of Chemistry,		Lahore.
Mr. Rashid Ahmad,	"	"	"
Mr. A. Hamid,	"	"	"
Kh. Nazir Ahmad,	"	"	"
Mr. Bashir Khokhar,	"	"	"
Mr. S. M. Bashir,	"	"	"
Mr. M. Sarwar,	"	"	"
Mr. Riazur Rehman,	"	"	"
Mr. Ghulam Hasan,	"	"	"
Mr. Abdul Hameed Bhatti,	"	"	"
Mr. Muhammad Bashir,	"	"	"
Mr. M. D. Joseph,	"	"	"
Mr. Mahmud Asghar,	Dept., of Chemical Technology,	Panjab University,	"
Mr. Abdul Rashid,	"	"	"
Mr. Mahmudul Hasan,	"	"	"
Mr. Muhammad Aslam,	"	"	"
Mr. Karam Elahi Babar,	"	"	"
Mr. Fazal Rasul,	"	"	"
Mr. Afzal Hayat,	"	"	"
Mr. Zainul Abedin,	Physics Department	"	"
Sh. Ghias-ud-Din,	"	"	"
Mr. Shams-uz-Zaman,	"	"	"
Mr. Mohd. Aslam,	"	"	"
P. Samuel,	"	"	"
Mr. Arif-uz-Zaman,	"	"	"
Mr. Akram Khan Lodhi,	Department of Psychology,	Government College,	"
Mr. Obaidur Rahman Khan	"	"	"
Miss Safdar-un-Nisa	"	"	"
Miss Chand Khurshid	"	"	"

PROGRAMME OF THE SESSION

Monday, April 3, 1950 5-15 p. m.	Recitation from the Holy Quran Welcome Address by the Chairman Reception Committee, Professor A. B. A. Haleem Inauguration of the Conference by His Excellency Al-Haj Khwaja Nazim-ud-Din, Governor General of Pakistan. Address by the General President Dr. Nazir Ahmad Report of the Pakistan Association for the Advancement of Science by the General Secretary Dr. Bashir Ahmad Messages of Goodwill
Tuesday, April 4, 1950 10-00 a. m. to 12-30 p. m.	Symposium (Entire Conference) Science Teaching in Pakistan.
2-30 p.m. to 4-30 p.m.	Opening speech by Prof. M. Afzal Husain Reading of papers or Symposia in all Sections Presidential Address : Agriculture Section President : Sir William Roberts* (2-30 p.m.) Presidential Address : Physics Section (2-30 p.m.) President : Dr. Abdul Haque
4-00 p. m.	Meeting of the Committee of the Council for the award of Research Fellowships.
5-30 p. m.	Reception to Delegates and Members by H. E. the Governor General of Pakistan.
Wednesday, April 5, 1950 9-00 a. m.	Meeting of the Council, Pakistan Association for the Advancement of Science.
10-00 a.m. to 12-30 p.m.	Symposium (Entire Conference) Problems of Land Reclamation in Pakistan. Opening speech by Dr. A. G. Asghar.

*In the absence of Sir William Roberts his Presidential Address was read by Sir Roger Thomas.

- 2-30 p. m. to 4-30 p. m. Reading of papers or symposia in all Sections.
 Presidential Address : Chemistry Section (2-30 p. m.)
 President : Dr. S. D. Muzaffar.
- Persidental Address : Engineering Section
 President : K. B. Sheikh Abdul Hamid. (2-30 p. m.)
- 6-45 p. m. Annual General Meeting of Pakistan Association of Scientific Workers.
- 7-00 p. m. Popular Lecture and Film Show.
- Thursday, April 6, 1950 Symposium (Entire Conference) Education in a changing world (including the bearing of Islamic ideology)
 10-00 p. m. to 12-30 p. m. Opening speech by : Dr. M. Hasan.
- 2-30 p. m. to 4-00 p. m. Reading of papers or symposia in all Sections.
 Presidential Address : Education Section
 President : Dr. M. Hasan. (2-30 p. m.)
 Presidential Address : Medicine Section (3-30 p. m.)
- 4-00 p. m. Business meetings of the various Sections
- 7-45 p. m. Popular Lecture by Dr. M. R. Madwar
 on 'Our Universe.'
- Friday, April 7, 1950 Whole-day Excursions to places of scientific and historical interest in and around Karachi.
- 9-00 a. m. Meeting of the Council, Pakistan Association for the Advancement of Science.
- 6-00 p. m. Annual General Meeting of the Pakistan Association for the Advancement of Science.
- 8-30 p. m. Sind University Banquet and Farewell to Delegates and Members.

OPENING PROCEEDINGS

ADDRESS OF WELCOME

By

PROF. A. B. A. HALEEM,

Vice-Chancellor, Sind University and Chairman, Reception Committee

YOUR EXCELLENCY, MR. PRESIDENT, LADIES AND GENTLEMEN,

I deem it a privilege to be in a position to extend a cordial welcome on behalf of the Sind University and the Reception Committee to all the delegates to the Second Pakistan Science Conference. It is a source of gratification to me as well as to the members of the Syndicate of the University that the Pakistan Association for the Advancement of Science accepted our invitation to convene the Conference at Karachi. It is in the fitness of things that this Conference, representing men of Science engaged in different spheres of national activity should assemble in this city. Besides being the seat of the Federal Government of Pakistan, Karachi is a rapidly growing centre of trade, commerce and industry, and the seat of what remains up to date the youngest University in Pakistan. It has also a unique geographical position in the Muslim world, situated as it is between the countries of the Middle East on the one hand and Indonesia on the other,

It is also my privilege to convey my grateful thanks as well as the grateful thanks of all the members of the Reception Committee to His Excellency Al-Haj Khwaja Nazimuddin, Governor-General of Pakistan, for having graciously consented, in the midst of his multifarious engagements and in spite of the heavy responsibilities which rest on his shoulders, to inaugurate the Conference. I am sure that his presence in our midst today will be a source of stimulus and encouragement to all workers in the field of Science.

Pakistan is a new State which has just emerged from the travails attending its birth. It is a State with great potential resources, and its future progress and well-being depend on the manner in which those resources are tapped and developed. Our economy is essentially agricultural at present and is likely to remain so for some time to come. The bulk of our population lives in the rural areas and is dependent, directly or indirectly, for its source of living on agriculture. The problem of agriculture, which still follows primitive methods, is therefore not merely to ensure the nation's food supply but to make it a source of decent livelihood for those dependent on land. The attainment of these objectives involves not merely the application of scientific methods to agriculture but also drastic social changes in our rural economy which, it may be hoped, the wisdom of our legislators will carry through in a peaceful manner.

While devoting adequate attention to the problems connected with agriculture we cannot afford to put the question of industrial development on the shelf. Our future depends on progress in every possible field and the planned and balanced development of our economy, but if we are to move at a satisfactory pace we must keep abreast of the latest advances in Science and Technology and make our own contribution to the advancement of scientific and technological knowledge. Being a late comer in the field of industrial progress we cannot afford to follow traditional and outmoded methods in our schemes of industrialisation, and must undertake investigation and research in the basic as well as the applied sciences on a scale commensurate with our national requirements in a highly competitive world. This demands co-ordinated effort by the Government, the Universities and the public. Thanks to the foresight and acumen of our next-door neighbours and our erstwhile compatriots, all the all-India institutions of higher research were located in Hindu-majority areas, and, consequently, when this sub-continent was partitioned, they all remained on the wrong side of the border. It is high time that steps were taken to establish Central Research Institutes for the furtherance of research in different branches of Science which may, in course of time, develop into a number of more or less independent institutions.

Owing to the paucity of funds the Universities of Pakistan are not in a position to play their proper role in the field of scientific investigation. It seems desirable in this connection to urge on the Central Government the necessity of setting up a University Grants Committee for the purpose, *inter alia*, of examining and subsidising schemes for the development of research in different branches of Science. The Inter-University Board of Pakistan has, for the last two years, been pressing on the attention of the Government the necessity of establishing a University Grants committee, but no steps have so far been taken to implement its recommendations. The industrialists of Pakistan also have a duty in this connection. In the United Kingdom, the United States of America and other countries of the West, industrialists are fully conscious of the vital importance of scientific and technological research. Besides endowing research fellowships and subsidising scientific and technical investigation in the Universities, the bigger industrial concerns in Europe and America maintain laboratories and research organisations of their own on a lavish scale and at very considerable expenditure, amounting, in some cases, to hundreds of thousands and even millions of pounds. One of the many valuable functions which a Conference of Scientists can discharge is to make the public realise the vital role of Science in modern life and to make our industrial community research-minded.

Ladies and Gentlemen, I shall be failing in my duty if I close my speech without conveying to the delegates who have come from far and near to take part

in the deliberations of the Conference my regrets and the regrets of all the members of the Reception Committee for the inadequacy of the arrangement we have been able to make for their accomodation and their comforts. It is customary to apologise to one's guests at the time of their departure for not looking after them properly. I and my colleagues of the Reception Committee are so conscious of the shortcomings in our arrangements that we have decided to offer apologies in advance.

Your Excellency, I thank you once more for honouring us by accepting our invitation and request you to inaugurate the Conference.

INAUGURAL ADDRESS

By

HIS EXCELLENCY AL-HAJ KHWAJA NAZIM-UD-DIN

Governor General of Pakistan

MR. PRESIDENT, LADIRS AND GENTLEMEN,

It is a matter of great pleasure for me to inaugurate the Second Pakistan Science Conference. First of all, I should like to welcome all the scientists gathered here to participate in the deliberations of the Conference.

I particularly welcome the delegates from overseas who have responded to our invitation and have come from long distances to join their brother scientists in their work. I am sure their visit will prove helpful to their Pakistani colleagues and we on our part shall do our best to make their stay in Pakistan pleasant and fruitful.

Science today plays a dominant part in the life of man as of nations. The entire industrial structure of the West has been built up with the help of science and the prosperity and the high standard of living of the peoples of those countries are the direct outcome of the development of science and technology.

In violent contrast to this pageant of progress is the backwardness of most of the Eastern countries where the bulk of the people live in subhuman conditions—wallowing in ignorance and dirt. It would appear as if they live in an altogether different planet which has been by-passed by the progressive forces of science.

The average cultivator in Pakistan still uses the same type of implements as were used by his for-bears thousands of years ago. Centuries have rolled by him without making any impression on his methods of production. No wonder his yield per acre is about the poorest in the world. While a farmer in the U.S.A, with a few assistants, can look after a farm extending over hundreds of acres—thanks to the modern conveniences and implements that science has placed at his disposal—we are still arguing whether the optimum size of the holding a *Hari* can effectively cultivate should be four acres or five.

This is only one illustration, but is capable of application in other spheres of our activities. If we are to build our State on progressive lines and bring about a radical change in the living conditions of our people, we shall have to make them scientific minded and harness the resources of science for the solution of the problem facing the country.

The Government of Pakistan envisage an expenditure of 300 crores of rupees on various nation-building activities during the next ten years. In that great and worthy task of development, science and scientists must play their full part. I feel that the deliberations of this Conference and future conferences of this kind will prove extremely helpful in that work.

It is a source of gratification to me that the Pakistan Association for the Advancement of Science was founded soon after the establishment of Pakistan. During its short existence of two years the Association has made considerable progress.

Among its achievements I particularly commend the publication of its Journals, the "Pakistan Journal of Science" and the "Pakistan Journal of Scientific Research," which are the first scientific journals to be published in Pakistan.

The First Pakistan Science Conference, organised by the Association last year, was a notable step towards the development of science and technology in the country.

Apart from papers dealing with scientific research, which were read at the Conference, symposia were held on a number of subjects of national importance, among which were agricultural and forest wealth of Pakistan and possibilities of its development; future of industrial development in Pakistan; the problem of waterlogging; Scientific Education; nutrition problem in relation to health and food resources; problem of national script and adult education.

The main achievement of the Conference was to bring together scientists from different regions and from different institutions to discuss these vital problems and focus public attention on them.

The Second Conference I am inaugurating today will provide an opportunity for taking stock of the results achieved during the last one year, for comparing notes about advances made in different fields of science, for discussing work done in various institutions, private, semi-official or official and for reviving old contacts. All this will lead to better co-ordination in the scientific field and more rapid development of science and technology in the country.

Your Association has many important tasks in front of it. Promotion of scientific research should be its main concern. Research is the chief instrument of progress, and in the competitive world in which we live today, we can survive only if we keep in the vanguard of new knowledge.

It is satisfying to learn that Messrs Imperial Chemical Industries and His Highness the Aga Khan have provided funds to the Association for the creation

of Research Fellowships. I hope that our industrialists and public-spirited citizens will also help in this essential task.

With the increasing use of science in our daily life, the responsibilities of scientists have also increased. We have to ensure that the role that science plays is constructive rather than destructive; that the new discoveries of Science, the new sources of energy and power which Science places at our disposal are used for promoting the well-being of humanity and not for bringing about its destruction; that Atomic energy is harnessed not for blasting populous cities but for beneficent activities; that the world does not live in constant dread of Hydrogen Bombs and other destructive missiles.

Above all, the cultural value of science, namely its simple and honest objectivity, its untiring perseverance in the search for truth, its meticulous care and accuracy of observations and its international character should be made to pervade the daily life of our people.

Mr. President and delegates, I wish your Conference every success.

MESSAGES OF GOODWILL

1. From the President, The British Association for the Advancement of Science, London, to the President of the P.A.A.S., Karachi.

The Officers and Council of the British Association send cordial greetings to you and your fellow officers and to all the members of the P.A.A.S.

We are particularly pleased that your generous invitation has made it possible for us to be represented at your Second Conference by one of our General Secretaries, and we send with our greetings all good wishes for the success of your meetings in Karachi.

We learned with great interest over a year ago that your Association had been established in Pakistan, and shall welcome news of the progress of the great work to which you have so courageously set your hands.

We value most highly the opportunity given to us at this stage to be associated with your pioneer efforts to develop science and its applications in Pakistan, and if it should be thought that there are any specific ways in which we might be able to help you to achieve our common objects we shall be glad to be informed.

We sincerely trust that the contacts between our Associations which you have initiated, may grow naturally and happily into those bonds of friendship and collaboration which unite the majority of Associations for the Advancement of Science.

2. **From the
United Nations Educational Scientific and Cultural Organisation, Paris,
(Represented by Prof. W. E. Purnell and Dr. Alexander Wolsky.)**

It is with the greatest pleasure that I convey on behalf of our Director General, to you assembled here today, the best wishes of Unesco for a successful conference.

There are now many Associations for the Advancement of Science, among which are some like the British Association for the Advancement of Science or the Australian and New Zealand Association for the Advancement of Science or the triple A (American Association for the Advancement of Science), which have been working for many decades, yet others are like that in Thailand, which is only four months old, but all have the same broad objectives in advancing the interests of science, promoting peace among nations and intellectual freedom in order that science may continue to advance and spread more abundantly its benefits to all mankind.

It is Unesco's constant duty and endeavour to stimulate international collaboration between these Associations for the Advancement of Science, and it was for this reason and to express to you his admiration for your courage and initiative in starting this Association from scratch that Dr. Torres Bodet, our Director General, was especially gratified to receive an invitation to send two delegates to your conference. I have had an opportunity of seeing the progress of the conference and it seems to me that this will be one of the best antidotes for our worst enemy "complacency," and I sincerely hope that as a result of the symposia to be held in the conference further important improvements will be instituted in the scientific endeavours of Pakistan for the development of your country.

Perhaps in the not too distant future it may be possible to hold a regional symposium of representatives of Associations for the Advancement of Science from Egypt to Pakistan and you may be interested to know that Unesco is encouraging the formation of a World Federation of Associations for the Advancement of Science. In the meantime especially from our Cairo and Pakistan offices but also from all the other regional science cooperation offices, I wish to extend to you the offer of all the assistance within our power.

**3. From the Egyptian Institute of Scientific Culture, through their Delegate,
Dr. Mohamed Rida Madwar Bey.**

As a delegate of the Egyptian Institute of Scientific Culture to the Second Pakistan Science Conference, I can assure you that it is both an honour and a pleasure to me personally to visit this wonderful sister country Pakistan, and to attend the meetings and Conferences of its distinguished men of science.

There is a common aim amongst men of science, namely, the search of truth, and out of this aim springs a bond of friendship, to which you men of science of Pakistan have given a beautiful and ample expression.

I bring you cordial greetings from men of science in Egypt, and the expression of their goodwill and heartfelt sympathy for all the efforts you are making towards the advancement of science.

PROCEEDINGS
OF THE
THIRD
PAKISTAN SCIENCE CONFERENCE
DACCA, 1951

PART I
OFFICIAL MATTERS
&
OPENING PROCEEDINGS



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LAHORE

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DACCA, 1951

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LAHORE

COUNCIL
OF THE
PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
FOR 1951

President

Hon'ble Dr. A. M. Malik, Minister for Health, Government of Pakistan.

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DAILY PROGRAMME

- Wednesday, Jan. 10, 1951.** *Inauguration of the Conference*
 10-00 a.m. to 12-00 noon. Curzon Hall, University of Dacca
- Recitation from the Holy Quran
 Welcome Address by the Chairman Reception Committee :
 Dr. S. M. Hossain
- Inauguration of the Conference by
 His Excellency Malik Muhammad Feroz Khan Noon
 Address by the General President :
 The Hon'ble Dr. A. M. Malik
- Report of the Pakistan Association for the Advancement of Science by the General Secretary,
 Dr. Bashir Ahmad
- Messages of Goodwill
- 1-00 p.m. to 4-30 p.m. Reading of Papers or Symposia in all Sections
- Presidential Address : Agriculture Section (2-00 p.m.)
 SUBJECT : A Review of the Agricultural Problems of East Pakistan
 President : Dr. S. Hidayetullah
- Presidential Address : Physics Section (3-00 p.m.)
 SUBJECT : The Theory of the Atomic Nucleus
 President : Dr. M. Razi-ud-Din Siddiqi
- 6-30 p.m. Reception by the Hon'ble Mr. Nurul Amin
- 7-00 p.m. to 8-00 p.m. Educational Films Show
- Thursday, Jan. 11, 1951.**
 9-00 a.m. to 12 noon.
- Reading of Papers or Symposia in all Sections
- Presidential Address : Biology Section (9-00 a.m.)
 SUBJECT : Planning of Biological Research in Fresh-water Fisheries
 President : Dr. Hamid Khan Bhatti
- Presidential Address : Engineering Section (10-00 a.m.)
 SUBJECT : Role of Engineers in the Development of the Country
 President : Pir Muhammad Ibrahim

Presidential Address : Chemistry Section (11-00 a.m.)
 SUBJECT : Chemists in the Service of Community
 President : Dr. Karimullah

2-00 p.m. to 4-00 p.m. Symposium (Entire Conference) :
 "Energy in the Service of Man and application of
 Atomic Energy"
 4-00 p.m. to 4-30 p.m. I. C. I. Fellowships Committee Meeting
 4-30 p.m. Afternoon Party, by the Chairman and Members of
 the Reception Committee
 8-30 p.m. Variety Entertainment (Curzon Hall)

Friday, Jan 12, 1951

9-00 a.m. to 12-00 noon. Reading of Papers or Symposia in all Sections
 Presidential Address : Geology Section (9-00 a.m.)
 SUBJECT : Climatic Regions of West Pakistan
 President : Dr. K. S. Ahmad
 Presidential Address : Medicine Section (10-00 a.m.)
 SUBJECT : Prevention and Cure
 President : Colonel E. G. Montgomery
 Presidential Address : Education Section (11-00 a.m.)
 SUBJECT : Psychology, Sociology and War
 President : Professor Qazi Muhammad Aslam
 2 p.m. to 4 p.m. Symposium (Entire Conference) :
 "Future of Chemical Research in Pakistan"
 4-45 p.m. Tea Party by H. E. The Governor and Begum Noon

Saturday, Jan. 13, 1951

9-00 a.m. to 12-00 noon. Reading of Papers or Symposia and Business Meetings
 in all Sections (resolutions and other items
 pertaining to each section)
 2-00 p.m. to 4-00 p.m. Symposium (Entire Conference) : Food and Nutrition
 in relation to Environment and National Health
 4-30 p.m. Tea Party, by the Principal, and Members of the Staff
 of Ahsanullah Engineering College, Dacca
 8-30 p.m. Farewell Dinner by the Vice-Chancellor and the
 Executive Council of the University of Dacca

Sunday, Jan. 14, 1951

Visits and Excursions

OPENING PROCEEDINGS

ADDRESS OF WELCOME

By

DR. S. M. HOSSA1N, M.A., LL.D., D. PHIL. (OXON.)

Vice-Chancellor, Dacca University, and Chairman, Reception Committee

YOUR EXCELLENCY, MR. PRESIDENT, LADIES AND GENTLEMEN,

I deem it a great privilege and pleasure to extend, on behalf of the University of Dacca and the Reception Committee, a most cordial welcome to the distinguished delegates and visitors to the Third Pakistan Science Conference. Soon after the Pakistan Association for the Advancement of Science came into existence and its First Conference was held at Lahore in 1949, this University extended its invitation to the Association for holding its Second Annual Conference at Dacca, but for the convenience of the foreign delegates and due to other important reasons, the venue had to be changed eventually from Dacca to Karachi. In spite of the temporary disappointment that we suffered owing to this sudden and last-moment change, we were, nevertheless, looking forward with much eagerness and expectation to the occasion when the Pakistani men of Science would muster strong from all parts of Pakistan to this historic city of Dacca and deliberate on the current problems of Science and its application towards the upliftment of the new nation.

Dacca, at one time, was the eastern bulwark of the Great Moghul Empire as the capital of Bengal. It had to pass through many vicissitudes in the role of its importance—first as the capital of the Subedars, then as the seat of Government of the Naib Nazims, and finally, for a brief spell of years, as the capital of Eastern Bengal. This city also stands as a land-mark in the history of the awakening of political consciousness among the Muslims of the Indo-Pakistan sub-continent and their emergence as a unified Muslim nation. It was here in this city of Dacca that in 1906 the Muslim League saw the light of the day for the first time under the inspiring leadership of the late lamented Nawab Sir Salimullah Bahadur of Dacca.

It is a matter of gratification that it has been possible to convene the Conference in this city—a city which had to bear the full brunt of the aftermath of partition inasmuch as within a comparatively short time it had to accomodate more than three times its original population and had also to shoulder the responsibilities of the seat of the Provincial Government, though its housing and other resources could not possibly be developed to the required extent within such a short time. Though the city has been growing day by day both in size and in importance, I must admit we are still not in a position to give the necessary comforts and

amenities required by our honoured guests and to extend our hospitality in the way we would have liked to, but I may assure them that we are not at all wanting in the warmth of our heart.

Science today has outgrown narrow geographical frontiers and national boundaries and has become truly international in character. Except in a limited sphere where scientific knowledge is being attempted to be utilised for destructive purposes in order to gain political power and supremacy, it can be generally said that results of scientific research are no longer kept confined to their discoverers as a secret treasure like the closely guarded clue to the treasure island or like the secrecy of a Magician's tricks. On the contrary, there is an ever growing tendency of keeping scientists throughout the world informed of recent developments in the various branches of science and also of enabling the general public to understand the practical applications and implications of science to modern life. That is why international scientific co-operation is being sought through the establishment of International Scientific Organisations and Institutes, where specialised knowledge and latest discoveries of scientific truth gathered from all parts of the world can be pooled together and utilised for the common object of contributing to the material well-being of mankind as a whole. The Pakistan Association for the Advancement of Science, I am sure, has a great and glorious role to play in the realisation of this objective. It will not only serve as a strong bond between the two far-flung wings of Pakistan in inspiring and encouraging the scientists and scientific workers of the two parts to devote themselves fully and coherently for the common good of the State, but will also act as a useful link with the world society of scientists outside. The task before the Pakistan's scientists is great indeed and their responsibility heavy. The eyes of the nation are on them as theirs is the main responsibility of guiding this under-developed new State of ours to the path of progress, plenty and prosperity. In this task they may draw inspiration from the Holy Qur'an, which repeatedly enjoins us to contemplate on the manifestations of nature, to unravel her mysteries and harness them to the service of man. This sacred injunction for the quest after truth found expression in the scientific eminence achieved by the Arabs in the early period of Islam. The contributions of the Muslim scholars in various fields of science were most fundamental and substantial; but very few of them are actually known to the present-day world of Science. It is the foremost duty of the scientists of Pakistan to bring to light the contributions made by them.

The century we are living in has witnessed an advance in man's mastery over the material universe unprecedented in the history of the world. Indeed, it has been held that the progress of the last 50 years equals, if not surpasses, that of the whole period of human history from the dawn of civilisation up to the year 1900. Rapid expansion of the frontiers of scientific knowledge has placed at the disposal of man tremendous powers and possibilities over natural forces

and resources which may be used both for good and for evil. As a result, in the world of today, no nation, great or small, can live in prosperity in peace time or in security in war time unless it is abreast with other nations in utilising science and scientific knowledge to the best advantage. Advances in science must be put to practical use for the nation's welfare which will mean adequate provision and distribution of energy for national utilities and services, stimulation of food production, prevention and cure of diseases, exploitation and conservation of the natural resources and last but not the least, for defence against outside aggression. To achieve these objectives, the flow of new scientific knowledge must be substantial and continuous; and for this, it is essential that the nation should have a policy of its own with regard to research and development in Science and Technology. It is in the fitness of things that the Association of Pakistan's Scientists should not only take the lead in framing a correct national policy in these matters but should also take their due share in its implementation.

At a time like this when the whole world is in a state of turmoil and when the nightmare of atomic warfare with all its disastrous consequences is haunting the minds of the individuals and the nations of the world, it is necessary that the scientists pause for a while and think as to what use they will make of their new knowledge. The answer may, perhaps, be given in the words of David E. Lilienthal, lately Chairman of the U.S.A. Atomic Energy Commission. Speaking about the problem of atomic energy and the great discoveries bound to come in its trail, he says,—

“First, we must persist until we find ways whereby mankind will not make use of these discoveries for destructive and evil ends.

Secondly, we must find ways of encouraging and stimulating the application of these discoveries and new ones to come, to things that are beneficial and helpful to mankind, and to the best of human aspirations.”

This applies not only to the field of atomic research but equally well to all other spheres of science.

While welcoming the distinguished delegates to the Conference to Eastern Pakistan, I deem it my pleasant duty to invite them to look for themselves into the special problems and potentialities of this part of Pakistan and discuss them fully with a view to putting the wheel of progress in motion along the right direction. I need hardly mention that East Pakistan, as most other parts of Pakistan, is almost entirely dependent on agriculture and the problem before us is to forge a type of balanced economy in which agriculture and industry will find mutual adjustment. Though we are poor in industries at present, our resources for building up industries of diverse character are by no means meagre. We are not also sufficiently aware of our full potentialities for want of systematic investigations and surveys. In order to raise the living standard of the people through fuller economic

development we have to see that agriculture and industry advance side by side and for that scientific knowledge and technical skill have to be applied in the improvement of agriculture, the methods of our communications including construction of ports and shipping facilities and the development of primary industries. East Pakistan is the land of the 'golden fibre'—the jute. In spite of frequent attempts being made in many countries of the world either to grow jute themselves or to find materials for its substitution, this golden fibre of Pakistan has held its own and still remains a virtual monopoly for us. It is the responsibility of the scientists and technologists to see that the threat of substitutes is not only reduced to the minimum but that newer and wider fields are discovered for its industrial use. The greater part of East Pakistan comprises the deltaic regions of the two great rivers, the Brahmaputra and the Ganges, and their numerous branches. With an extensive network of rivers and not too short a sea board, our Province presents great scope for the development of its fresh water, estuarine and marine fisheries. If the fishery resources of the Province are adequately tapped, and the industries based on them properly developed, it will not only provide the people with more food of richer quality but can also enable us to export processed and preserved fish in sufficient quantities to other countries. I would take the liberty of inviting the attention of the experts to this very important aspect of our economy.

Before I conclude, I would again remind the delegates who have come from far and near, of the inadequacy of our arrangements and convey my own apologies and apologies of the members of the Reception Committee for our many shortcomings of which we are so fully conscious.

In spite of these inconveniences, I am confident that under the able guidance of the General President, the Hon'ble Dr. A. M. Malik, this Conference will be a great success and its deliberations will prove immensely helpful to our planning for a better life.

It has been very kind of His Excellency Malik Feroz Khan Noon to have agreed to inaugurate this Conference in the midst of his heavy responsibilities and preoccupations. For this, we are all deeply grateful to him.

I would now invite His Excellency to kindly inaugurate the Conference.

INAUGURATION ADDRESS

By

HIS EXCELLENCY MALIK MOHAMMAD FIROZ KHAN NOON

Governor, East Bengal

MR. PRESIDENT, LADIES AND GENTLEMEN,

It is a great privilege and honour for me to inaugurate the present session of the Pakistan Science Conference. As I take part in the inauguration ceremony, I feel myself in the presence of a great cause and that of an equally great enthusiasm. The cause is the one that science has taken upon itself of seeking to establish conscious control over the environment of man. This cause acquires a special urgency in a country like ours where the standard of living is low, illiteracy wide-spread and the means to good life limited. Compared to the countries of the West, science has bestowed few fruits on us so far. Our industry has to make great progress in almost every possible direction. Our agriculture is outmoded and wasteful, our economy needs scientific planning and thorough remodelling. Research laboratories which are essential for the progress of trade, commerce, industry and general welfare of our masses are non-existent. Therefore your devotion to science—which is the only instrument of organised social engineering—is most appropriate and a matter of great hope for the country.

2. The challenge that the scientist in Pakistan faces today is a great one. He must boldly address himself to the work of turning an age-old raw material-producing country into a manufacturing one. For this he must transform and develop industry by the application of modern science and technology. A non-industrial country can have no effective say in world affairs. He must help multiply the country's agricultural productivity and improve the quality of the output for which there is an infinite scope, and be ready to meet the probable threat of invention of substitutes to replace important agricultural products. We must make the most of our eager and intelligent human material, explore and use our total potentiality and evolve an integrated economy in which both industry and agriculture will have their due share. For a balanced economy ensuring a decent standard of living for the villager it is essential that what he produces should have a good price, and for this purpose we must have at least 15 per cent. of our population engaged in industry and living in towns to consume the agricultural products. Therefore industrial development of the country is most essential for providing scope for research institutes and gainful employment for people of the cities as well as of the rural areas.

3. All resources must be laid at the disposal of the scientist ungrudgingly and in abundance for the study of our scientific problems and for experiment and research. Freedom, if anything, should mean freedom from hunger, ignorance and wearing toil. It is strictly limited by man's capacity for action which again depends on knowledge. It has been justly said that in so far as we do not know we cannot act and any freedom that we have must necessarily be illusory. It is, therefore, imperative that we must know and act. I strongly support your appeal for the establishment of a sufficient number of research and technological institutions and for opening faculties in our Universities for the teaching of all modern scientific subjects. The need has been acutely felt for facilities for technological research in the Dacca University of which we eagerly await the fulfilment. As a further impetus to scientific education the endowment of an increased number of scholarships for both under-graduate and post-graduate training in science seems called for.

4. The time has come when a comprehensive union of human thought and human enterprise has become absolutely necessary. A rational understanding and control of human environment, starting from the exact sciences of lifeless matter, has passed to the complex study of human personality and society. The physical sciences have come to depend more and more on their integration with other sciences and to play their part in the economics and politics of living societies. The need for inclusiveness is not limited to analytic thought and action. The sciences and arts should therefore aim at a unity which will extend itself towards social understanding and social needs. It is without any doubt true that the cultured man of today is relatively more ignorant, that is, knows less of what is known in the contemporary world than at any previous period in history. The remedy seems to lie in emphasising the unity of science and the humanities and in a more general scientific culture. The study of science is futile if the scientific attitude of mind is not brought to bear on the other problems of life. Precision, objectivity, scientific and profitable thinking can alone contribute to the making of a conscious civilization. This points to the necessity of liberalising scientific education in towns as well as in the villages and of informing the mind of the people with the true spirit of science. This will also act as a safeguard against obscurantism and reaction in the sphere of intellect. How to achieve this is for you to determine. I hope sincerely that the co-operation between yourselves and the Government of Pakistan produces fruits which will quickly make available for the common man in the future what other more advanced nations have enjoyed for decades in the past.

**PROCEEDINGS
OF THE
FOURTH
PAKISTAN SCIENCE CONFERENCE
PESHAWAR, 1952**

**PART I
OFFICIAL MATTERS
&
OPENING PROCEEDINGS**



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Dr. G. Jilani,	" "	"
Dr. A. Karim,	" "	"
Dr. A. Haq,	Engineering College,	"
Mr. Muhammad Ferdous Khan,	Asstt. Planning Adviser, D.P.I.'s Office,	"
Chawdhry Mehr Din,	Executive Engineer, Designs,	"
Mr. M. F. Khan,	Deptt. of Physics, Chittagong College,	Chittagong.
Dr. Nazir Ahmed,	Deputy Director of Fisheries,	E. Bengal, Comilla,

Karachi

Mr. Muhammad Aslam,	Director, Meteorological Service,	Karachi.
Mr. A. Waheed Khan,	" "	"
Mr. M. Rahmatullah,	" "	"
Mr. N. A. Qureshi,	" "	"
Dr. M. Qudrat-i-Khuda,	Ministry of Defence,	"
Mr. T. H. Hashmi,	Ministry of Communications,	"
Mr. S. H. R. Rizvi,	Asstt. Director of Education,	"
Syed Ibrahim Shah,	Food Development Adviser to Govt. of Pakistan,	"
Ch., Muhammad Afzal,	Pakistan Central Cotton Committee,	"
Dr. A. G. Riaz,	" "	"
Dr. Taskhir Ahmad,	Director, Plant Protection,	"
Mr. I. U. Khan,	O i/c General Stores Laboratory,	"
Mr. W. R. Owain Jones,	The British Council Representative,	"
Prof. J. B. Sidhwa,	Sind Science College,	"
Mr. Khalid Askary,	Journalist	"
Mr. S. M. Ayub,	Ministry of Industries,	"
Major Aftab Hussain,	Principal, Urdu College,	"
Dr. (Mrs.) B. B. Qureshi,	Central College for Women,	"
Prof. N. D. Aliz,	D. J. S., Govt. Science College,	"
Prof. S. H. H. Zaidi,	Sind Muslim College,	"
Mr. S. M. Hamid Ali,	Standard Vacuum Oil Co.,	"
S. Masood Hussain, Dy. Director of Navigation,	Central Engineering Authority,	"
Mr. S. Ghulam Mustafa,	Principal, S. M. College,	"

Punjab

Mr. M. A. Hameed,	Army Medical Stores Laboratory	Lahore.
Dr. Bashir Ahmad,	Institute of Chemistry, Panjab University,	"
Dr. Badar-ud-Din,	" " " "	"
Dr. A. Kamal,	" " " "	"
Dr. M. I. D. Chughtai,	" " " "	"
Dr. S. A. Faseeh,	" " " "	"
Dr. M. Amin,	" " " "	"
Mr. S. A. Warsi,	" " " "	"
Mr. Ather Hussain,	" " " "	"
Mr. Riaz-ur-Rehman,	" " " "	"
Mr. H. A. Kazmi,	" " " "	"
Mr. K. A. Moin-ud-Din Khan,	" " " "	"
Mr. M. Salah-ud-Din,	" " " "	"
Mr. A. H. Bhatti,	" " " "	"
Mr. S. F. A. Abidi,	" " " "	"
Dr. A. M. Mian,	Physics Department,	"
Dr. Abdul Basir Pal,	" " " "	"
Mr. Abdul Ghafoor Choudhry,	" " " "	"

Dr. H. K. Bhatti,	Department of Zoology, Panjab University,	Lahore.
Dr. Muzzaffar Ahmad,	" " " "	"
Dr. Kazi S. Ahmad,	Department of Geography, " "	"
Mr. Asrarullah,	Department of Geology, " "	"
Dr. John H. Martin,	Forman Christian College,	"
Dr. Robert H. Rodin,	" " "	"
Mr. Khairat Muhammad,	" " "	"
Mr. Lee. N. Scheuerman,	" " "	"
Mr. Joseph J. Manglam,	" " "	"
Mr. Muhammad Maqbool Ilahi,	Talim-ul-Islam College,	"
Mr. Nazir Ahmad,	" " "	"
Prof. M. Aslam,	Government College,	"
Dr. Ahmad Ali Qureshi,	" " "	"
Dr. M. Sharif,	" " "	"
Prof. Abdussalam,	" " "	"
Dr. M. Afaf,	" " "	"
Mr. L. M. Chawla,	" " "	"
Dr. Ameer-ud-Din,	Medical College,	"
Dr. G. M. K. Baloch,	" " "	"
Maj. S. M. K. Wasti,	" " "	"
Dr. Abdul Ghaffar,	" " "	"
Mr. F. D. Anjum Rumani	Dyal Singh College,	"
Mr. S. N. Naqvi,	Director, Meteorological Centre,	"
Mr. S. Taj-ud-Din,	M/s. May & Baker Ltd.,	"
Mr. M. O. Qureshi,	" " "	"
Mr. Stanby Gurnell,	The British Consul Representative,	"
Mr. S. Ali Naqi,	S. S. & T. Laboratories,	"
Dr. K. S. Shah,	Dean, Institute of Hygiene,	"
Sheikh Mumtaz-ud-Din,	Engineering College,	"
Mr. Y. S. Ahmed,	Chief Conservator of Forests, Punjab,	
Ch. Sardar Muhammad,		Lyallpur.
Mr. Muhammad Ihsan-ur-Rehman Khan,	Silvicultural Research Division,	"
Mian Allah Bakhsh,	Retired Chief Conservator,	"
Mr. Siraj-ud-Din,	Agricultural College,	"
Mr. M. A. Naqvi,	School for Military Engineers,	Sialkot.
Dr. M. M. Ahmed,	Army School	Upper Topa.
Mr. K. A. Waheed,	Inspector General of Forests,	Jhelum.
Prof. Champion		"
Maj. S. M. H. Bokhari,	C. M. P. Laboratory,	Rawalpindi.
Col. M. Akram,	Consultant Pathologist to Pakistan Army,	"
Lt. Col. T. A. Vahidy,	G. H. Q.	"
Maj. Afzal Hussain,	" " "	"
Dr. Muhammad Shah,	" " "	"

Sind

Sir Roger Thomas,	Agricultural Adviser, Sind Government,	Sind.
Mr. M. H. Haroon Khan.	Vice-Principal, Institute of Agriculture,	Sakrand.

North-West Frontier Province

Dr. Abdullah Jan,	Dubgori Gate,	Peshawar.
Mr. A. H. Alvi,	Chairman, Education Department, Peshawar University,	„
Prof. M. Fazil,	Government Islamia College,	„
Malik Fazal Dad Khan,	Entomologist, Tarnab Farm,	„
Mr. M. A. Aziz,	Agricultural Chemist, „ „	„
Mr. M. Suleman,	Economic Botanist, „ „	„
Mr. Abdul Mannan Khan,	Entomologist, „ „	„
Wing Commander H. A. Soofi,		„
Mr. A. Hamid Chotani,	Wah Cement Works,	Wah.
Mr. S. A. A. Anvery,	Forest College,	Abbottabad.
Dr. A. H. Khan,	„ „	„
Dr. Ghulamullah,	Pakistan Forest Research Institute,	„
Mr. M. A. H. Qadri,	„ „ „	„
Mr. M. Afzal Hussain Qadri,	„ „ „	„
Dr. S. Z. Hasnain,	Botanical Survey of Medicinal Plants,	„
Mr. Ikram Elahi Chaudry,	„ „ „	„
Mr. Inayatullah Khan,	Headmaster, Saidu School, Saidu,	(Swat).
Dr. M. Ishaque,	Pakistan Military Academy,	Kakul.
Mr. M. R. Haq,	„ „ „	„

Baluchistan

Dr. H. Crookshank.	Director, Geological Survey of Pakistan,	Quetta.
Dr. O. R. Khan,	Department of Agriculture,	„

STUDENT DELEGATES

M. A. Munir Ahmad.	Mukhtar Abdulla.	Muhammad Aslam.
M. Sarwar.	Muhammad Akram,	Khalil-ur-Rehman.
Abdul Mannan.	Muhammad Sharif.	Amir Muhammad.
M. Khurshid.	Ata-ur-Rahman.	Abdul Majid.
S. N. Naqi.	Ghulam Abbas.	Abdul Wahid.
Hidayatullah.	Rashid Ahmad Anwar.	S. A. Durrani.
Manzur-ul-Haq.	Ehsan-ul-Haq.	Arshad Ali.
Shaukat Azim.	Abdul Qadeer Beg.	Rafiq Ahmad.
Khurshid Bhatti.	Ghulam Rasul.	Fazal Ahmad.
Abdur Rahman.	M. Z. Cheema.	Abdus Sattar.
Latif Beg.	Abdullah Qureshi.	Sharifullah.
Zafar Ali Shah.	Munawar Ahmad.	Munawwar Ali.
Usmanullah.	Muhammad Ayub.	Muzaffar Ali.
Qurban Abbas.	Shamshad Ali.	Rashid Malik.
Muhammad Zaman	Salim Shahid.	

PROGRAMME

- Monday, March 17th** ... KHYBER UNION HALL, ISLAMIA COLLEGE,
PESHAWAR.
- 9-30 a.m.—11-00 a.m. ... *Inauguration of the Conference*
 Recitation from the Holy Quran
 Welcome Address by
 The Hon'ble Khan Abdul Qaiyyum Khan, Chief
 Minister, N.-W.F.P., and Chancellor, University of
 Peshawar.
 Inauguration of the Conference by
 His Excellency Alhaj Khwaja Shahabuddin,
 Governor, N.-W. F. Province.
 Address by the General President ;
 Dr. M. Qudrat-i-Khuda, Scientific Adviser to the
 Ministry of Defence, Karachi.
 Report of the Pakistan Association for the
 Advancement of Science by the General Secretary.
 Dr. Bashir Ahmad, Director, University Institute
 of Chemistry and Dean, Panjab University Instruc-
 tion, Lahore.
 Messages of Goodwill.
 Opening of the Exhibition by The Hon'ble Khan
 Abdul Qaiyyum Khan.
- 2-00 p.m.—4-00 p.m. ... SCIENCE BLOCK, ISLAMIA COLLEGE,
PESHAWAR.
- ... Reading of papers or symposia in all Sections.
Presidential Addresses :—
 Agriculture Section ... 2-00 p.m.
 Physics Section ... 2-45 p.m.
 Education Section ... 3-15 p.m.
- 4-15 p.m. ... Reception by Peshawar Municipality, (Assembly
Lawns.)
- 7-00 p.m. ... Popular Lecture by Dr. Nazir Ahmad, Chairman,
Pakistan Tariff Commission on "Science Thought
through Ages," at the Edward College Hall,
Peshawar City.

Tuesday, March 18th ... SCIENCE BLOCK, ISLAMIA COLLEGE,
PESHAWAR.

- 8-00 a.m.—12-00 noon. ... Reading of papers or symposia in all Sections.
Symposium on "Physics of the Earth and the Atmosphere" in Physics Section.
A Lecture by Dr. Bashir Ahmad on "Recent Development in the Carotenoid Field" in Chemistry Section at 8-30 a.m.
Presidential Addresses:—
Biology Section ... 8-30 a.m.
Engineering Section ... 9-00 a.m.
Chemistry Section ... 9-30 a.m.
- 10-00 a.m. ... Popular Lecture by Sir Ben Lockspeiser on "Application of Science in Industry."
- 11-30 a.m. ... Annual Meeting of the Pakistan Chemical Society.
- 2-00 p.m.—4-00 p.m. ... Reading of papers or symposia in all Sections.
- Afternoon ... Excursions—Tarnab Farm and Warsak.
Presidential Addresses:—
Medicine Section ... 2-00 p.m.
Geology: Geography ... 2-30 p.m.
- 3-30 p.m. ... Annual Meeting of the Pakistan Pharmaceutical Society.
Annual Meeting of the Pakistan Geographical Association.
- 7-00 p.m. ... Popular Lecture by Sir George Paget Thomson on "The New Fundamental Particles" in the Edwards College Hall, Peshawar City.

Wednesday, March 19th... KHYBER UNION HALL, ISLAMIA COLLEGE,
PESHAWAR.

- 8-00—12 noon. ... International Symposium on "Scientific Land Utilization."
- 12 noon—1-30 p.m., ... Luncheon Interval—Members of the West Regional Branch of the Pakistan Association for the Advancement of Science at home to the members of the East Regional Branch and delegates from Overseas.
- 1-30 p.m.—4-30 p.m., ... International Symposium—2nd Session.

Thursday, March 20th ... KHYBER UNION HALL, ISLAMIA COLLEGE, PESHAWAR.

- 8-00 a.m.—12 noon. ... International Symposium—Third Session.
 9-00 a.m.—12 noon. ... Reading of papers or symposia in all Sections
 1-15 p.m. ... Excursion to Khyber Pass
 7-00 p.m. ... Popular Lecture by Sir Henry Tizard on "Science and National Welfare" in the Khyber Union Hall, Islamia College, Peshawar.

Friday, March 21st ... KHYBER UNION HALL, ISLAMIA COLLEGE PESHAWAR.

- 9-30 a.m. ... Popular Lecture by Prof. A. V. Hill on "Chance, Curiosity and Reason in Scientific Discovery."
 11-00 a.m. ... Meeting of the Pakistan Association of Scientific Workers.
 4-15 p.m. ... Reception by H. E. the Governor at the Govt. House.
 8-30 p.m. ... Search Light Tatoo by the N.-W. F. P. Police.

Saturday, March 22nd ... ISLAMIA COLLEGE, PESHAWAR.

- 8-30 a.m. ... Business Meetings of the Sectional Committees in various Sections.
 10-00 a.m. ... Council meeting to consider the decisions and resolutions of the Sectional Committees.
 2-00 p.m. ... Annual General Meeting of the Pakistan Association for the Advancement of Science.
 7-00 p.m. ... Farewell Dinner by the Peshawar University

Post Conference Lectures in Lahore

1. "The Nature of Muscular Contraction" By Prof. A. V. Hill, (24th Mar.)
 2. "The Foundations of Mathematics" By Dr. Kerim Erim, (25th Mar.)
 3. "The Contribution of Descartes to Science" By Dr. Kerim Erim, (26th Mar.)
 4. "The Nature of Physical Law" By Sir George Thomson (26th Mar.)
 5. "Calvanometers Photo-electric Amplification and the Measurement" By Prof. A. V. Hill, (27th Mar.)
 6. "Industry in Egypt" By Dr. Ahmad Bey Zaki, (27th Mar.)
 7. "Atomic Energy" By Sir George Thomson, (27th Mar.)
 8. "Electron Diffraction" By Sir George Thomson, (28th Mar.)
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OPENING PROCEEDINGS

ADDRESS OF WELCOME

By

THE HON'BLE KHAN ABDUL QAIYYUM KHAN,

Chancellor of the University of Peshawar

YOUR EXCELLENCY, MEMBERS OF THE SCIENCE CONFERENCE,
LADIES AND GENTLEMEN,

I extend a very hearty welcome to the members of the Fourth Annual All Pakistan Science Conference. The University of Peshawar considers it a proud privilege that this Conference should be meeting under its auspices.

2. For a layman like myself, it would be presumptuous, in such a gathering of illustrious scientists, to speak on the great role that Science has played in human life in the last couple of centuries and on the still greater future that lies ahead of it. Without belittling in any way pure Science which is admittedly of fundamental significance, what as a practical man of affairs I am chiefly interested in, is its application to human life. It is only when Science has come out of the laboratories and its results and methods are made available for the common man that we can be said to be getting full benefit from scientific research.

3. As this session of the Science Conference is being held at the capital of the North-West Frontier Province, it would be only in the fitness of things, if I drew the attention of the scientists to the problems of applied Science with which we are faced in this country.

Power Resources

4. The problem of developing our power resources is perhaps the most fundamental one. In this Province, we have, on account of the bounty of Providence, an abundant supply of river-water so placed and located as to be capable of being pressed into service for generating electricity on a large scale. We have made what may perhaps be regarded as a promising beginning with tapping this power resource and hope, in the coming years, to develop it as much as possible. In the normal course, all the energy that we may be able to produce will be consumed within the Province itself on the electrification of towns and villages and for industrial purposes, but until

all of it can be utilised here, part of it can be made available for those parts of the Panjab which adjoin this Province. That may enable the Panjab to become independent of the supply which it has been getting from its neighbour on the other side—the East Panjab.

Problems of Seepage, Waterlogging and Erosion

5. The water which helps us to generate electric energy also irrigates our agricultural land through canals. But, here it creates a new problem which the practical administrator cannot solve without the help of the scientist. Irrigation canals have their undoubted advantages but they also produce the evil of seepage and waterlogging which, if left unchecked and uncountered, can do immense harm by rendering large tracts of land altogether unfit for cultivation.

6. The problem of erosion of land is of a similar character and also calls for effective measures scientifically applied for its solution.

Problem of Agricultural Yield

7. Perhaps our main problem in agriculture is that of getting the maximum possible yield per acre of land brought under cultivation. We cannot expect in a country like Pakistan, where land has been under cultivation for centuries, as much yield per acre as in a virgin country, we are certainly not getting here all that we should. This calls for all the help that Science can give. The activities of our Agricultural Department need to be modernised.

Subsidiary Industries for the Agriculturist

8. Scientific cultivation of land is one way of enabling the farmer to produce the maximum material wealth that he can get out of the land he brings under the plough. Another way of helping him to raise his all-too-low standard of living is by finding remunerative work and occupation for the considerable time he finds left on his hands after attending to his daily routine on the farm. At least two such occupations are easily within his reach, namely, keeping of bees and rearing of silk-worms. These two occupations are by no means new in this country but even age old activities can be made more gainful if their technique is modernised in the light and with the help of the new knowledge that Science has made available.

9. The cultivation of tobacco is giving to the farmer here an excellent opportunity of adding to his slender income. After he has cured his tobacco, the process is continued and completed in a modern curing factory at Akora Khattak. Thereafter a cigarette-making factory at Karachi lends a hand to turn out the finished product. But this, by no means, exhausts the possibilities of

what can be done in the matter of growing tobacco and manufacturing cigarettes. More is bound to come later.

Sugar

10. This Province has always occupied a leading place in growing sugar canes of excellent quality. Our Sugar Factory at Mardan is the biggest factory of its kind in the whole of Asia. It is a good example of the application of Science in the service of agriculture. But, it would be wise not to rest on our oars and research for the discovery of cheaper and more efficient methods of manufacture should be kept up.

Forests

11. Our forests offer in their own way another sphere for the application of Science. If trees and other plants are allowed to grow and flourish without let or hindrance, a forest soon becomes a jungle, creating fresh problems of its own. If, on the other hand, trees are cut down indiscriminately, the land is denuded with unfavourable effects on the soil, rainfall and the general climate of the country. Thus, in both these directions, one has to tread warily which means proceeding scientifically. A plentiful supply of good, cheap timber is essential if we are to solve successfully the problem of housing our people decently—a problem which has become more than usually acute since Partition. Instead of leaving it to the individual householder to build his own house (as has been the practice so far in this and other countries in the East) it might be worth-while to try and start a house-building industry which could carry on the work on a large scale when it would be more practicable to make use of all the help that Science can give in the matter.

Fruit Producing Industry

12. This Province also offers much scope for the growth of the fruit-producing industry. The soil and the climate are of the right sort and the fruit-growers have an age-old tradition of efficient work at their back. The chief snag, of course, is that but for the few months of winter, the rest of the year is not suitable for storing fruit. Science can come to the help of the fruit-grower by developing good but comparatively inexpensive methods of cold-storage, dehydration, desiccation and processing. We have made a beginning on these lines but much more can and should be done in this connection.

Medicinal Plants

13. In addition to the timber, which our forests supply us, we get medicinal plants which can be of great use for the manufacture of drugs. If the work of organized research on these plants is taken up in right

earnest and kept up with patience over a period of years, we may come to develop in our country pharmaceutical industry of great value.

Match and Paper Industries

14. Our forest wealth can also be used for two other industries which, at the present moment, are practically non-existent in our country. One is the match-making industry and the other the paper-making industry. It is a disgrace to have to depend for our matches on foreign countries when manufacturing this simple article of everyday use does by no means present any insuperable difficulties. As to the paper-making industry, it is obvious that a country like Pakistan where literacy and education are still far from being well-developed, a yearly-increasing supply of paper will be needed for many years to come. Paper is almost like an indispensable ingredient of intellectual food and just as no country can afford not to be self-sufficient in the matter of food for the body, it cannot afford not to be self-sufficient in the matter of what is almost a vital ingredient of food for the mind.

Woollen Textile Industry

15. Mention of food brings to my mind the question of clothing our people particularly in winter which is quite rigorous in these parts. There is ample scope for a woollen textile industry as some parts of the country are ideal for rearing sheep. Instead of sending our wool to foreign countries and depending on them to manufacture it into cloth for our use, we can very well do the manufacturing in our own country and thus supply ourselves with good cloth cheaply, providing at the same time employment for quite a large number of our people.

Leather Industry

16. A predominantly agricultural Province like the North-West Frontier has a large cattle population which can provide material for a flourishing leather industry. But when the Province is predominantly meat-eating too, it should be possible for it to maintain such an industry all the more easily. We have made a beginning in this direction by setting up a leather-tanning factory at Nowshera, which, I hope, will be followed in course of time by more and better factories for the same purpose.

Prospecting on a Large Scale

17. I do not believe that this country is lacking in deposits of coal and oil. The oil that the Middle East is producing now was supposed to be non-existent until about half a century ago. What is needed is prospecting on a large scale not only for oil and coal but for other possible minerals that may be lying hidden—only waiting to be discovered.

Health and Disease

18. But the wealth of a country is more correctly measured by the number of healthy men, women and children to be found in it than by the number of rupees, dollars or pounds that they make between them. The problems of health and disease are, therefore, of more fundamental significance than problems of any other kind. Like other parts of Pakistan this Province too suffers from the legacy of its immediate past. The medical facilities available here are none of the best nor do we have enough of them—measured by any reasonable standard. Diseases, both preventable and others, cause much suffering and take a heavy toll of life. Some of these diseases are caused by poverty and ignorance while others are due to the increasing complexity of life. As life becomes more and more complex, the human body, in its reactions to its environment, comes to suffer newer and greater stresses and strains with the inevitable result that the harmony of its various parts is upset and disease follows. But it should be the business of science—of medical science in this case—to rise to the height of the occasion and find suitable measures and remedies to meet the new situation. The clock of progress cannot be set back and life restored to its old-age simplicity. The only alternative therefore is to meet the new situation with the help of the medical science.

19. These are some of the problems with which we in this Province are faced. They are being tackled to the best of our ability but we need to increase that ability so as to be able to produce even better results. It is here that the application of Science to the problems of life can come to our rescue.

20. The University of Peshawar has already planned the teaching of Science at the post-graduate level—it being intended to start with a college of Engineering and Technology to be followed up with the Departments of Physics, Chemistry, Botany, Zoology and Geography. When these Departments are properly set up and get going, our endeavour will be to strike a proper balance between teaching and research and between pure Science and applied Science. And our aim through all our theory and practice will be advancement of knowledge and the service of humanity.

21. I wish the Conference godspeed in its work and conclude with an expression of my earnest hope that its deliberations during the coming week will prove of great value to the welfare and progress of the country.

INAUGURATION ADDRESS

By

HIS EXCELLENCY KHWAJA SHAHABUDDIN,

Governor, North-West Frontier Province

LADIES AND GENTLEMEN,

We, in the North-West Frontier Province, feel greatly honoured to have the Fourth All-Pakistan Science Conference in our Capital. Peshawar has its roots embedded deeply in the past, and although its history has been characterised by much unquiet and instability yet in learning and scholarship it claims an ancient lineage. A short distance away from this hall there are mounds which were once Buddhist monasteries where men of piety devoted themselves to the pursuit of knowledge. These monasteries were the true precursors of our modern universities, for they were essentially societies of scholars bound by a common purpose and subject to a rigorous intellectual and moral discipline. On their ruins stands to-day the University of Peshawar whose motto 'رب زدنی علما' ('Increase our knowledge, O Lord') represents the high esteem and reverence accorded to learning in Islamic culture.

2. This Province, which before the establishment of Pakistan was educationally very backward, has not much to boast by way of institutes of scientific research or learning. Leave alone scientific institutions, it did not even have enough elementary schools. To-day, thanks to the vision and energy of its Government and the enthusiasm of its people, the picture is rapidly being transformed. We have still a considerable leeway to make up, but the omens are highly favourable. The University of Peshawar, which is in the second year of its existence, embodies our hopes and aspirations, and we are confident that in the fullness of time it will become one of the leading centres of humanistic and scientific learning.

3. It is one of the ironies of the partition of India that of all the important institutes of scientific research hardly a single one is to be found in the territories constituting Pakistan. We inherited three Universities only, of which one—the University of Sind—was barely six months old and therefore completely undeveloped, while two—the Universities of the Panjab and Dacca—suffered great damage as a result of the whole-sale migration to

India of their non-muslim teachers. These are very grave handicaps for a new country which is anxious to invoke the aid of science and technology for the development of its natural resources and the raising of the standards of living of its teeming millions. It is greatly to the credit of our scientists that they should have taken up the cause of scientific advancement so earnestly and organised this conference which enables them to meet every year and deliberate upon the many problems of pure and applied science with which this country in particular and the world in general is faced.

4. We Muslims were late in entering the field of modern education during the British rule. Much worse, through mistaken notions, we displayed an attitude of hostility towards science, and it was only recently that we grudgingly realised the vital importance of scientific education. The woeful consequences of such an attitude revealed themselves starkly when we achieved our freedom. Whether we want to establish a scientific institution or a mill or a factory we have neither personnel nor equipment. The survey conducted by the Scientific Manpower Committee, which the Central Government appointed soon after the establishment of Pakistan, showed serious deficiencies in many important branches of science. These deficiencies are being remedied to some extent partly through the Overseas Scholarship Scheme of the Central Government and partly through the facilities offered under the Commonwealth Programme of Technical Assistance, President Truman's Point Four Programme and similar other plans so generously initiated by friendly foreign Governments. We welcome the foreign experts who have come under these programmes to teach us the "know-how" of modern science and technology with special reference to our problems of economic development and I have no doubt that our own men, who have gone out to America, the Dominions and other countries, will come back to us with improved technical skill and knowledge to help us accomplish the tasks that lie before us. But invaluable as this foreign assistance is in the solution of our immediate problems, we must not on any account overlook the fundamental problems of establishing and equipping our own institutions in order to produce our own personnel. For this purpose the teaching of science at all levels of education assumes the highest importance.

5. I have no doubt that this matter will receive your earnest consideration and you will be able to suggest practical ways of accelerating the pace of scientific education.

6. Research is the life-blood of science and the paucity of facilities for research is obviously a matter of deep concern to all of us. We have as yet no national laboratory in any of the important branches of science,

This is again due to the fact that we do not possess enough of scientific talent of high calibre to man such laboratories or the requisite equipment which can only be handled by skilled persons. We thus find ourselves in a vicious circle. High-powered laboratories are essential to our economic development but we cannot have them because of the paucity of personnel and the lack of equipment. And because we cannot have the laboratories, we cannot make progress in the field of economic development. This vicious circle has got to be broken as our survival in a highly mechanised and competitive civilization is at stake. We possess an abundance of natural resources which, for their proper exploitation, provide unlimited scope to the scientists. Applied science has miraculously transformed the entire economy of areas that were once barren and unproductive. I need only mention the Tennessee Valley Project in the U. S. A. as an illustration of the beneficent use of modern scientific techniques and processes. A similar illustration is provided, though on a much smaller scale, by the Malakand Hydro-electric Project in this Province. Development of water power apart, we in Pakistan are faced with several problems such as water-logging in the Punjab, perpetual inundation in East Bengal or arid zones in West Pakistan, which need all the technical skill and knowledge of our scientists for their immediate solution. We must not, however, lose sight of the fact that modern scientific research is an extremely costly business. In planning it, therefore, we should safeguard ourselves against the dangers of duplication. Nor should we in an excess of enthusiasm initiate ambitious projects which the resources of our country in money and manpower are unable to sustain.

7. If there is one fact in the contemporary civilization which is incontrovertible, it is the rapid tempo of its change. Doubtless, the world has never been static; but what differentiates the world of our fore-fathers a century ago from the world we live in is that whereas their lives followed a familiar and leisurely rhythm, ours are whirled from change to change. There were inventions and discoveries in the past and, however great their impact, society was soon able to readjust its rhythm. To-day every scientific advance subjects the pattern of society to an intolerable pressure which often disrupts it and demands a painful readjustment. Thus mankind finds itself in a precarious situation whereby technological development is outstripping its capacity for readjustment and is causing deep alarm and anxiety to all its thinkers. How are we to meet the challenge of this unprecedented crisis of our civilization—a crisis which is as much intellectual as it is moral?

8. Because the revolutionary character of scientific development is the prime cause of this crisis, I would be the last person to cry halt to any further scientific development or to propose that science should be completely

outlawed and banished from the world. That would be indeed a counsel of despair and as a remedy worse than the disease itself. Science is knowledge—a patient, unending quest for the true secrets of the Universe. To forego this quest, which Islam has sanctified and blessed, is to forego the essence of all that constitutes us, in the words of the Holy Quran, “Ashraf-ul-Makhlūqat,” the crown of creation. For as long as man lives, there will be worlds upon worlds of knowledge for him to conquer and secrets after secrets of Nature to surprise. And for as long as there is want or disease, the scope for the beneficent application of scientific knowledge will be inexhaustible. As a layman it exceeds my competence to tell you what possibilities exist in atomic energy which, to our sorrow and consternation, has assumed for the present the horrid shape of a destructive bomb. If we are to believe scientists, there are other frontiers, hitherto unknown, which are in sight and accessible. Thus we are assured that the problem of overpopulation with its threat of food scarcity need not vex our minds because there are as yet untapped sources of food, clothing and vital minerals in the oceans. Solar energy, we are further told, is another source, which if scientifically exploited, will improve our lot beyond recognition. If such are the hopes which science holds out, it also provokes fears which mock them and turn what should be a pleasant dream into a nightmare.

9. The common man, and it is for him that I speak, lives his life in anxiety and insecurity. There is, I am convinced, a great deal which the scientists can do to free his mind from the grip of anxiety, for there is nothing which he desires more ardently than peace and security. Within the short span of thirty years he has supped full of the horrors of two wars, the second more dreadfully than the first. These wars have been fought with all the immense technological resources which science has placed at the disposal of the belligerents. He has the excuse of bitter experience if only the sinister aspects of scientific advance looms large before his vision. I am familiar with the argument which some apologists of science have put forward. The scientist's is the disinterested pursuit of knowledge, regardless of results and their consequences. Where the use of this knowledge raises fundamental moral problems, they plead neutrality. Should one accept this argument, it would imply that the scientist belonged to a different order of creation, a spectator and not a participant of human affairs. I, for one, cannot accept this argument nor, I am happy to say, do the vast majority of scientists themselves. They cannot abjure their humanity.

10. The highest end of knowledge, according to Islam, is that it should lead to the material and spiritual perfection of man. While inevitably the concern of the scientist must remain with the world of matter, it is now

widely realised that materialism is not enough and that he needs what one of the most distinguished scientists of our day, Einstein, has called a "cosmic religious feeling." This implies that it is the responsibility of this scientist to see that his contribution to knowledge promotes and does not destroy the true happiness and contentment of mankind. It is in the hope and conviction that I inaugurate this Conference. Knowledge is power but the fruits of power, unless they are nourished by spiritual values, are invariably bitter. The true source of these spiritual values, as Islam teaches us, lies in the consciousness that the ultimate object of the life of man is that he shall live in the service of God. If, in the path of knowledge as in any other path of life, we keep this object steadily in view, the survival and progress of mankind are assured.

GOODWILL MESSAGES

H. E. Mr. Ghulam Mohammad, Governor General of Pakistan.

It gives me great pleasure to send this message of greetings and goodwill to the Fourth Pakistan Annual Science Conference which is being held at Peshawar. The presence at this Conference of distinguished scientists from foreign countries is very welcome.

We are living in an age in which science is making rapid progress. Men of science have, therefore, splendid opportunities of service to humanity. All peace-loving people look to them to continue ceaselessly their noble efforts to abolish disease, ignorance and poverty. Science unfortunately has led to discoveries which are not being used for the service of man. The growth of international conscience, moral and natural restraints among both men of science and men of action would, it is hoped, provide the necessary checks on such tendencies.

We in Pakistan are still very backward in the higher sciences. We have a long and difficult task before us to come up to the standard of the more progressive nations in this respect, but I am sure that with the inspiration of our heritage of scientific thought and pioneering spirit we shall be able to surmount the difficulties that lie in our way.

I am very glad that the Conference will hold, in collaboration with the Unesco an International Symposium on the subject of "Scientific Land Utilisation." This subject is of vital interest to Pakistan and it is hoped that the deliberations at this symposium will be of great practical value to us.

I wish the Conference all success.

H. E. Malik Feroz Khan Noon, Governor of East Bengal.

I wish the Fourth Annual Pakistan Science Conference all success. The advancement of scientific knowledge in Pakistan is our crying need. It is only through science that we can make the earth yield its fruits in ample quantity to raise the standard of living of our people. It should be a compulsory subject at school and there should be more research institutes and laboratories to help our trade and industries.

The National Academy of Sciences of the United States of America and the American Association for the Advancement of Science.

It gives me sincere pleasure to send to you of the Pakistan Association for the Advancement of Science greetings from the American Association for the Advancement of Science and the National Academy of Sciences of the United States of America. Although we are widely separated from you by distance, our common devotion to the furtherance of science has fostered friendships we value highly. We recognise with gratitude our debt to you for scientific knowledge and philosophical concepts which have enriched our culture and stimulated our own efforts to improve human welfare through science.

In thinking of you on this occasion we are reminded that the furtherance of scientific research in all countries increases the spiritual and material resources of all nations whose citizens are free to hear, to speak, to question. We would reaffirm our wish to join with you in scientific explorations, which are among the great adventures of the human spirit. We would join with you in thus liberating men from the uncontrolled domination of natural forces and from ignorance and superstition.

It is a pleasure to send these words of greetings to a nation that is one of the British Commonwealth of Nations. It is an especial pleasure to send the greetings by the hand of a Foreign Associate of the National Academy of Sciences who does not consider himself a foreigner in our country or yours, because he has the true affection of a scientist for the scientists of all countries who respect our common heritage of excellence.

In these times when a selfish few would use restricted scientific knowledge to enslave great numbers, we prize our friendly association with the British Commonwealth in the faith that science can free men from the imagined necessities for greed and conflict by increasing their intellectual and material welfare.

With cordial greetings, I am

(Sd.) DETLEV W. BRONK,
President.

E. J. Salisbury, Esqr., Secretary, The Royal Society, London.

The Royal Society has learned with interest from two of its former Officers of the meeting of the Pakistan Association for the Advancement of Science which is to take place in March of this year, and at which a number of Fellows of the Society will be present. The Society is therefore asking Professor A. V. Hill, a former Secretary, to convey to the Association its most cordial good wishes, not only for the immediate success of the meeting about to be held, but also in the widest possible sense for the prosperity of all science in Pakistan.

Pakistan is passing through an eventful stage in its history. Whatever hopes and fears may be entertained for the future, the friendly connections which unite the Royal Society through individual men of science to bodies like the Pakistan Association remain a source of abiding satisfaction in this country and we hope in Pakistan itself.

There is no need to enlarge upon the benefits which the improvement of Natural Knowledge confers upon every country where it is pursued. In this sense the Royal Society is glad to feel that in extending its good wishes to the men of science in Pakistan it is also expressing its concern for the happiness and prosperity of the people of that country.

The British Association for the Advancement of Science, London.

On the occasion of the Annual Meeting of the Pakistan Association for the Advancement of Science the Council of the British Association send friendly greetings and every good wish for the success of the meeting.

We are delighted that the generosity of the Pakistan Association has made it possible for the British Association to be represented by the President, Professor A. V. Hill, and a past President, Sir Henry Tizard, and we welcome this opportunity of being directly associated with the proceedings in Peshawar. We sincerely hope that our representatives and other senior scientists from Britain may be able to contribute something of lasting value to the formal and informal discussions and we shall look forward to receiving from them a report of their visit to Pakistan.

We believe that Associations such as yours and ours have two very important functions to perform at the present time. The first is to provide a regular occasion for scientists to describe and to interpret advances in science to each other and to the public who are now, more than ever before, the patrons of science. The second is to make regular opportunity for scientists of different disciplines and from different countries to meet each other for discussions and consultation on common problems. We have watched the growth of your young Association with great interest and send every encouragement in the great work which your Officers and Members have undertaken, not only in the interests of Pakistan for which science can do so much, but also for the general good, since advances anywhere in scientific knowledge and its applications have universal interest and significance.

The President, Fouad I National Research Council of Egypt, Cairo.

On behalf of Fouad I National Research Council of Egypt, I offer you the best of greetings on the occasion of the Fourth Annual Pakistan Conference of your Association and wish you whole-heartedly the same success that attended your former meetings.

We, here in Egypt, feel towards you a general sympathy that springs from our realisation that science gives the basic material benefits and, let us hope, the basic moral values that are needed for human progress on all fronts, and for human understanding and world peace.

But we also feel towards you a special kind of sympathy which springs from our realisation that our two countries are among the latest nations which obtained their natural right to direct their own destinies in a world full of confusion and misunderstanding. To take immediately to science as one of the first steps in shaping these destinies is a mark of sagacity which is not foreign to the East. The East is the cradle in which human knowledge was first born, as far as our own knowledge of human history goes. From the East it went to Greece and Rome and from there it went further West to Europe which developed wonders in the last two centuries or so. Now we, the Eastern peoples, are getting back what we gave, in a highly developed form, and it is our intention to catch up to it, and to share in its development for self defence against nature and against those who may not believe in the destiny of man and equal opportunities for all, of whatever colour or race.

Another source of our mutual sympathies, Mr. President if I may be allowed to refer to it, is the cultural background that we both have, and the faith that gave us both the same democratic way of life. It is the faith which, from its beginning, urged the use of the human mental power, in elucidating and understanding nature, and therefore, introducing oneself to that unified and supreme power that controls and directs our universe. It is that rare faith, as far as I know, that adopted the scientific method as the means of salvation and the one that was liberal enough, and broadminded enough, as not to deny those that disagreed with it honestly, the ultimate mercy of our Creator, the Merciful, the Compassionate.

On these three counts, may I, Sir, repeat my greetings to you and to the members of the Association, and offer my sincerest wishes for a successful and a happy future for the people of Pakistan.

Prof. A. N. Terzioglu, Dean of the Faculty of Science, University of Istanbul.

The Faculty of Science of the University of Istanbul conveys its sincere congratulations to the Association for the Advancement of Science of Pakistan, on the Fourth Anniversary of its foundation.

Our Faculty trusts that your Association, prompted by the fecundity of mind characteristic of the Orient, will always contribute its valuable share to scientific progress for the benefit of mankind; and we are convinced that modern science will continue to flourish in the East, from whence came first the light of civilisation with unequalled splendour.

United Nations Educational Scientific and Cultural Organisation
(Represented by Prof. W. E. Purnell).

On behalf of the Director General of Unesco, whom I have the honour of representing in this region, I wish to express his very best wishes for the success of your Conference.

This is the Third Pakistan Science Conference I have had the privilege of attending and it is our hope in Unesco that as a result of the interest shown by the Pakistan Association for the Advancement of Science, other Associations for the Advancement of Science or their equivalents will be formed in other countries of the Middle East and just as we are endeavouring to support the P.A.A.S. in every way possible within our limited means, so we hope to assist other Associations for the Advancement of Science as they are formed.

Among the many activities of the P. A. A. S. that of encouraging science at the secondary school and college level is perhaps the most important for the future progress of Pakistan and here we are commencing a co-operation between P. A. A. S. and Unesco, with the supply by us of drawings of simple scientific apparatus capable of being made here, that I hope will engender a real interest in science in an increasing number of the younger generation.

During the course of the conference there will be held a Symposium on Scientific Aspects of Land Utilisation that we have had the pleasure of assisting financially. This is the second such Symposium we have aided in the Middle East. I hope we will be able in the future, to increasingly assist in the field of symposia. The next we have planned is a joint symposium sponsored by my office and the South Asia Science Cooperation Office which it is hoped will be held early in 1953 on SOLAR ENERGY and we sincerely trust the P. A. A. S. will take the most active part in it.

May I thank you for this opportunity of conveying my Director General greetings to you, confident in the thought that this Fourth Pakistan Science Conference will be an even greater success than previous ones.

Dr. T. Grivet, Head, Technical Assistance Division, Department of Natural Science, Unesco.

I have great pleasure in bringing the greetings of Unesco to this important Science Conference called by the Pakistan Association for the Advancement of Science and to have the opportunity of expressing the very great interest of Unesco in these activities. Unesco aims towards peace through education, science and culture and feels that science is a ground where collaboration and cooperation are easiest to achieve. The calling of scientific conferences and activities directed towards developing science or expanding scientific knowledge are among the most successful means of achieving this object.

As a woman scientist I also express the wish that more and more women of Pakistan will undertake the work of learning and teaching of science and the undertaking of scientific research. I hope women of Pakistan will take their due share in scientific congresses and side by side with their brothers, through the means of science, work for the uplift of humanity.

PROCEEDINGS
OF THE
FIFTH
PAKISTAN SCIENCE CONFERENCE
LAHORE, 1953

PART I
OFFICIAL MATTERS
&
OPENING PROCEEDINGS



PUBLISHED BY
PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
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Part I - Official Matters & Opening Proceedings

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- Dr. A. B. Pal, Department of Physics, Panjab University.
- Dr. M. Ishaque, Pakistan Military Academy, Kakul, N-W.F.P.
- Professor Abdussalam, Government College, Lahore.
- Mr. S. N. Naqvi, Director, Meteorological Department, Lahore.
- Dr. A. M. Mian, Head, Department of Physics, Panjab University.
- Professor A. L. Shaikh, Principal D. J. S. Govt. Science College, Karachi.
- Dr. R. M. Chaudhury, Government College, Lahore.
- Mr. D. M. Qureshi, Punjab Agricultural College, Lyallpur.
- Mr. A. R. Nasir, Department of Mathematics, Engineering College, Lahore.
(*Secretary*).
-

LOCAL SECRETARIES AND ORGANISING COMMITTEES

- GENERAL** : 1. Dr. Niaz Ahmad, Director, University Institute of Chemical
Techonology.
2. Kh. Salah-ud-Din.
3. Mr. Salah-ud-Din.
4. Mr. A. K. Qureshi.
5. Mr. Ijaz Ahmad Malik.
- FINANCE** : 1. Dr. Badar-ud-Din, Head, University Institute of Chemistry.
2. Captain Kabir Ahmad Sheikh, Department of Industries, Pb.
3. Mr. A. Basir, Department of Industries, Panjab.
4. Mr. Rashid Ahmad Anwar.
5. Mr. Qamar-ud-Din Ansari.
- RECEPTION AND
ACCOMMODATION** 1. Dr. Kh. Zia-ud-Din, Zoology Department, Panjab University.
2. Mr. Mohammad Afzal, Deputy Registrar, Panjab University.
3. Dr. M.I.D. Chughtai, Pb. University Institute of Chemistry.
4. Mr. Munir Husain, Department of Industries, Punjab.
- INAUGURATION
ARRANGEMENTS** Mr. M. A. Rahim, Assistant Registrar, Panjab University.
Mr. Manzoor-ul-Haq Hashmi.
Mr. Osman-Ullah.
- PUBLICITY** : M. Abdussalam Khurshid, Head, Department of Journalism,
Panjab University.
Mr. Hameed-ud-Din, Department of History, Panjab University.
Mr. Hamid Jalal, Radio Pakistan, Lahore.
Mr. S. Haider, Department of Public Relations, Punjab, Lahore.
- EXHIBITION** : Mr. A. A. Abbasi, Superintendent, Industrial and Commercial
Museum, Bank Square, Lahore.
Mr. Mohammad Shafi, Industrial Research Laboratory,
Lahore.
Mr. M. A. Fazili, Industrial Research Laboratory.

- LECTURES : Dr. S. A. Faseeh, Institute of Chemistry, Lahore.
Mr. Riazur Rahman.
M. Ather Husain.
M. Mo'in-ud-din.
- ENTERTAINMENT : Dr. Niaz Ahmad, Director of Institute of Chemical Technology.
Mr. Iftikhar Mohyuddin.
Mr. Afzal Hayat.
- VISITS AND EXCURSIONS : (a) Local - Mr. Imtiaz Ahmad, Law College, Panjab University,
(b) Lyallpur - Mr. Saeed Zahid, Panjab University Institute of Chemistry.
(c) Sheikhpura - Kh. Amjad Husain, Warden of Fishries
- SECTIONS : A. Agriculture : Ch. Mohammad Amin, Lyallpur.
B. Biology : Dr. Muzaffar Ahmad, Department of Zoology, Panjab University.
C. Chemistry : Dr. M. I. D. Chughtai, Institute of Chemistry.
D. Education : Miss Chand Khurshid, Department of Psychology, Government College.
Mr. Ahmad Kamal, Training College.
E. Engineering : Mr. Jabbar Sherwani, Engineering College.
F. Geology, Geography : Mr. Asrarullah, Department of Geology, Panjab University.
G. Medicine : Dr. M. Abdussalam, Veterinary College.
H. Physics : Mr. A. R. Nasir, Engineering College.
- ENQUIRY OFFICE : Mr. Asrarullah, Department of Geology Panjab University,
Dr. Mohammad Amin, Head, Department of Pharmacy, Panjab University.

RECEPTION COMMITTEE

CHAIRMAN : Mr.S. M. Sharif, Director of Public Instruction and Secretary to the Punjab Government (Education), Lahore.

Professor M. Afzal Hussain, 51/3 Lawrence Road, Lahore.

Sir William Roberts, (B. C. G. A.) Civil Lines, Khanewal.

Mr. T. C. Williams, (B. C. G. A.) Civil Lines, Khanewal.

Mr. Mohammad Shafiq, Brisk Engineering Works, Lahore.

Syed H. Naqvi, Y. M. C. A. Building, Lahore.

Mr. Rashid Randhawa, Central Scientific Company, Bank Square, Lahore.

Dr. A. G. Asghar, Director, Land Reclamation, Lahore.

Mr. Aziz Omar, M/s. Omar Sons, Mason Narsing Das Building, Lahore.

Habibur Rahman, Habib's(Pakistan)Ltd. The Mall, Lahore.

Mr. Fazal Din, M/s. Mohammad Din & Sons, Lahore.

Mr. A. B. Akram, Commercial Buildings, The Mall, Lahore.

Dr. Nazir Ahmad, Chairman, Pakistan Tariff Commission, Karachi.

Mr. C. M. Latif, Batala Engineering Works, Lahore.

Dr. G. M. K. Baloch, Professor of Medicine, Fatimah Jinnah Medical College, Lahore.

Dr. Khan A. Rahman, Agricultural Finance Corporation, Lahore.

Malik Amanat Khan, Director of Agriculture, Punjab, Lahore.

Dr. Abdus Sattar, Plant Pathologist, Agricultural College, Lyallpur.

Dr. H. K. Bhatti, Head of the Department of Zoology, Panjab University.

Dr. S. A. Faseeh, University Institute of Chemistry, Lahore.

Professor Abdussalam, Head, Department of Mathematics, Panjab University, Lahore.

Dr. (Mrs.) B. B. Qureshi, Central Government College for Women, Karachi.

Dr. Abdul Ahad, 3, Nisbet Road, Lahore.

Dr. S. M. Namus, Bakhshi Market, Anarkali, Lahore.

Lt.-Commander Agha Abdul Latif, Punjab Agricultural College, Lyallpur.

Dr. Nazir Ahmad, Physicist, Irrigation Research Instt, Punjab, Lahore.

Dr. Niaz Ahmad, Director, Institute of Chemical Technology, Lahore.

Kh. Salahuddin, Institute of Chemical Technology, Panjab University.

Dr. Bader-ud-Din, Head, University Institute of Chemistry, Lahore.

Mr. A. R. Ghani, Fazl-i-Omar Research Institute, Model Town, Lahore.

Mr. S. N. Naqvi, Director, Meteorological centre, Lahore.

Dr. Karimullah, Deputy Director of Industrial Research, Panjab, Lahore.

Dr. Muhammad Amin, Head, Department of Pharmacy, Panjab University, Lahore.

Mr. Hasan Ahmad, Public Analyst, Lahore Corporation.

Messrs Allied Engineers and Traders Limited.

Dr. Sadiq Hussain, Toor Manzil, Beadon Road, Lahore.

Ashfaq Hussain, Esqr., We Brothers, The Mall, Lahore.

Rana Nazar-ur-Rahman, We Brothers, The Mall, Lahore.

Syed Shabbir Ahmad, We Brothers, The Mall, Lahore.

Mr. Aziz-ur-Rehman, We Btothers, The Mall, Lahore.
 Mr. M. A. Ahsan Ilahi, National Rubber Works Sialkot.
 Mr. Zafar Rai, M/s Kata Engineering, Works.
 Dr. M. Abdussalam, Panjab Veterinary College, Lahore.
 Maj. L. S. Cruikshank, May & Baker, Lahore.
 Mr. Y. S. Ahmad, Inspector Genral of Forests.
 Prof J. M. Benade, F. C. College Lahore.
 Dr. M. Sharif, Biology Department, Government College, Lahore.
 Prof.O. A. Broch, Panjab Universty, Lahore.
 Mrs Broch, Ferozepur Road, Lahore.
 Prof M. Asjam, Government College Lahore.
 S. A. Rahim, M/s Muhammad Din & Sons.
 M/s Volkart Brothers.

D O N O R S

Mirza Bashir-ud-Din Mahmud Ahmad, Rabwah.
 Mr. Naseer A. Sheikh, Managing Director, Colony Textile Mills, Multan.
 Mr. C. M. Latif, Batala Engineering Co., Lahore.
 Mr. S. A. Rahim, S. Mohammad Din & Sons, Y. M. C. A. Building, Lahore.
 Sir Roger Thomas, Agricultural Adviser, Sind Government, Karachi.
 Mr. Ahsan Elahi, National Rubber Works, Sialkot.
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 Imperial Electrical Company, The Mall, Lahore.
 Mallick Diesels Limited, The Mall, Lahore.
 Mr. Rashid Randhawa, Central Scientific Company, Bank Square, Lahore.
 Major L. S. Cruickshank, Manager, May & Baker, Limited, Lahore.
 Messrs. Thal Cement and Stoneware Factory, Lahore.
 Messrs. A. Ismailji and Sons, Rawalpindi.
 Messrs. Mian Mohammad Allah Bakhsh, Lahore.
 Sheikh Zahur Ahmad, Director, Pb. Vegetable Ghee & General Mills.
 M/s Fazal Din & Sons, The Mall Lahore.
 Mr. Aziz Omer, M/s Omer Sons Ltd.
 M/s Pakistan Industries Ltd.
 M/s Associiated Instruments Manufacturers, Ltd.
 The Karachi Company Ltd, 11-A, Lawrence Road Lahore.

PROGRAMME

Monday, Feb. 16, 1953. Inauguration of the Conference : Panjab University
9-00 a.m. to 11-00 a.m. Hall, Lahore.

Recitation from the Holy Quran.

Welcome Address by the Chairman, Reception Committee,
Mr. S. M. Sharif, Secretary to Govt. Punjab (Education).

Inauguration of the Conference by
His Excellency Mr. I.I. Chundrigar, Governor of the Punjab
and Chancellor, Panjab University.

Address by the General President,
Dr. Bashir Ahmad, Vice-Chancellor, Panjab University.

Report of the Pakistan Association for the Advancement
of Science by the General Secretary,
Dr. Karimullah.

Messages of Goodwill.

11-30 a.m. Opening of the Exhibition in the Lecture Hall attached to
the Museum by
Dr. Salimuzzaman Siddiqui, Director, D.S.I.R., Karachi.

Afternoon Session

2-30 p.m. to 3-30 p.m. **Inauguration of the Pakistan Academy of Sciences, at
the University Hall.**

Recitation from the Holy Quran.

Welcome Address by the General President, P. A. A. S.,
Dr. Bashir Ahmad.

Inaugural Address by the
Hon'ble Al-Haj Khwaja Nazim-ud-Din, Prime Minister of
Pakistan,

Introduction of Foundation Fellows by
Professor M. Afzal Husain.

A synopsis of the constitution of the Academy of Sciences
by Dr. M. Razi-ud-Din Siddiqui.

Concluding Remarks by
Dr. Nazir Ahmad.

- 4-30 p.m. Reception at the University Institute of Chemistry
- 6-00 p.m. Public Lecture in the University Hall,
Speaker : Sir Harold Hartley, K.C.V.O., F.R.S.
SUBJECT : The Art of Discovery.
- 8-30 p.m. Educational Films ; Y.M.C.A. Hall.

Tuesday, Feb. 17, 1953.

9-00 a.m. to 12-00 noon Reading of Papers or Symposia in all Sections

- 9-00 a.m. Presidential Address : Agriculture Section in History
Lecture Theatre, No. 1, Panjab University,
SUBJECT : Scientific Planning for Development of Agriculture,
Animal Husbandry and Forestry.
President : Mr. Y. S. Ahmad.
- 9-00 a.m. Presidential Address : Physics Section in History Lecture
Theatre No. 2, University Hall.
SUBJECT : Sampling and Sampling Distribution.
President : Dr. M. Zia-ud-Din.
- 10-00 a.m. Presidential Address : Education Section
University Hall, Lahore.
SUBJECT : Islamic Ideology ; A Critique.
President : Professor B. A. Hashmi.

10-00 a.m. Presidential Address : Biology Section in Room No. 10,
Deptt. of Botany, Government College.
SUBJECT : The Need of Biological Study in Pakistan.
President : Dr. S. Hidayetullah.

11-00 a.m. Lecture in the University Hall.
Speaker : Professor H. J. Bhabha, F.R.S.

11-00 a.m. Lecture in Medicine Section, Veterinary College.
Speaker : Dr. Grant L. Stahly.
SUBJECT : Sanitation and Disease.

12-00 noon to 2-00 p.m. Lunch Interval.

1-30 p.m. Annual Meeting of the Pakistan Association of Scientific
Workers.

Afternoon Session

2-00 p.m. to 3-00 p.m. Reading of Papers or Symposia in all Sections.

2-00 p.m. Lecture, Biology Section.

Speaker : Dr M. A. Fikry.

SUBJECT : Another Attempt Towards Identifying the
Chromosomes of *Vicia Faba*.

4-30 p.m. Reception at the Talimul Islam College,

6-00 p.m. Public Lecture in Talimul Islam College.

Speaker : Professor C. R. M. Cuthbert.

SUBJECT : Some interesting aspects of recent medico-legal
investigation of crime.

8-30 p.m. Educational films in the Y.M.C.A. Hall.

Wednesday, Feb. 18, 1953

9-00 a.m. to 12-00 noon Reading of Papers or Symposia in all Sections.

9-00 a.m. Presidential Address : Medicine and Veterinary Sciences
Section, in Lecture Theatre, Veterinary College.

SUBJECT : Abu Ali Al-Husain Ibn Abdulla Ibn Sina, the
Physician.

President : Dr. G. M. K. Baloch.

9-00 a.m. Presidential Address : Geology and Geography Section in
Department of Geography, Panjab University.

SUBJECT : Some Aspects of Mineralogy.

President : Professor Olaf Anton Broch.

- 10-00 a.m. Presidential Address : Chemistry Section in Chemistry Lecture Theatre, Institute of Chemistry.
SUBJECT : Synthetic Fertilizer Industry in Pakistan.
President : Dr. Ali Ahmad.
- 11-00 a.m. Lecture, Medicine Section, in the Veterinary College.
Speaker : Professor C. R. M. Cuthbert.
SUBJECT : Application of Science to Criminal Investigation.
- 11-00 a.m. Lecture, in History Lecture Theatre, Pb University.
Speaker : Dr. M. A. Fikry.
SUBJECT : The Inheritance of Characters.

Afternoon Session

- 2-00 p.m. to 4-00 p.m. Reading of Papers or Symposia in all Sections.
- 3-00 p.m. Lecture in the University Hall.
Speaker : Sir Harold Hartley.
SUBJECT : Limits in the factors of production : Availability of energy in the arid zones.
- 4-30 p.m. Reception at the University Institute of Chemistry
- 6-00 p.m. Public Lecture in the University Hall.
Speaker : Dr. George Taylor.
SUBJECT : South East Tibet, its Plants and People.
- 8-00 p.m. Drama by the Students Dramatic Club, (University Lawn.)

Thursday, Feb. 19th, 1953

- 9-00 a.m. to 11-00 a.m. Reading of Papers or Symposia in all Sections.
- 11-00 a.m. Lecture, in the University Institute of Chemistry.
Speaker : Dr. Grant Stahly.
SUBJECT : Development and Commerical Production of Antibiotics.
- 11-00 a.m. Lecture in the University Hall.
Speaker : Dr. Muhammad Aziz Fikry.
SUBJECT : Cotton Breeding in Egypt.

Afternoon Session

- 2-00 p.m. to 4-00 p.m. Reading of Papers or Symposia in all Sections.
 2-00 p.m. Presidential Address : Engineering Section.
 SUBJECT : The Engineers' Burden.
 President : Mr. Mohsin Ali.
- 3-00 p.m. Lecture by Sir Claude Inglis,
 Director, Hydraulics Research Station, Berks, England.
 SUBJECT : Hydraulics and Models.
- 6-00 p.m. Public Lecture by Dr. Nazir Ahmad.
 SUBJECT : Scientific Thought Through Ages.
- 7-00 p.m. Variety Show by East Pakistan Cultural Association in
 Y.M.C.A. Hall.

Friday, Feb. 20th, 1953

- 9-00 a.m. Business Meetings of Sections and Learned Societies.
- 11-00 a.m. Lecture by Dr. A. Ghaffari.
 SUBJECT : Recent Advances of High Speed Aircraft.

Afternoon Session

- 2-00 p.m. Annual General Meeting of the Pakistan Association for the
 Advancement of Science.
- 4-00 p.m. Demonstration of Electron Microscope at the Institute of
 Chemical Technology.
- 8-30 p.m. Educational Films in Y.M.C.A. Hall.

Saturday, Feb. 21st, 1953

- 9-00 a.m. to 11-00 a.m. Meetings of Learned Societies.
- 11-00 a.m. Lecture in the University Institute of Chemistry.
 Speaker : Dr. George Taylor.
 SUBJECT : Work of the British Museum.

Afternoon Session

- 2-00 p.m. Visits and Excursions
- 6-30 p.m. Farewell Banquet.

Sunday, Feb. 22nd, 1953 Excursions to Lyallpur and Sheikhpura.

LIST OF DELEGATES

Britain

Sir Harold Hartley, K.C.V.O., F.R.S., President of the World Power Conference, 1953.
Dr. George Taylor, Secretary, British Association for the Advancement of Science.

Egypt

Dr. Mohammad Aziz Fikry, Professor of Botany, University of Alexandria.

India

Dr. H. J. Bhabha, D.Sc., F.R.S., Director, Tata Institute of Fundamental Research.

Iran

Dr. A. Gaffari, Professor of Mathematics, University of Tehran.

Turkey

Dr. Arif Ismet Qatingil, Dean of the Faculty of Medicine, University of Istanbul.

Unesco

Prof. W. E. Purnell, Head, Science Co-operation Office for Middle East, Cairo.

Overseas Scientists in Pakistan

Sir Claude Inglis, C.I.E., Director of Hydraulic Research, D.S.I.R., U. K.

Prof. C.R.M. Cuthbert, Harvard Institute of Legal Medicine, U. K.

Mr. H. R. Mills, M.Sc., A.M.I.E.E., Regional Representative, British Council.

Lt. Col. F. M. Oag, M.I.E., Director, Central Engineering Authority, Karachi.

Dr. G. L. Stahly, Professor of Bacteriology, Ohio State University, U.S.A.

Dr. Chester R. Lodge, (U.S.A.) attached to the Peshawar University.

Mr. Guy Miller, (U.S.A.) TCA, American Embassy, Karachi.

Mr. D. R. Hooton, (U.S.A.) TCA, attached to the Agricultural College, Lyallpur.

Mr. O. J. Eigesti, (U.S.A.), attached to the Panjab University, Lahore.

Mr. A. B. Winterbottom, Unesco T.A. Mission, Engineering College, Dacca.

Mrs. Else Broch, B.Sc. (Oslo), Representing Norsk Botanisk Forening, (Norway).

Dr. Statius Muller, UNTAA. Dr. Karl Wienert, UNESCO.

Mr. David L. Guyer, „ Miss M. J. Aarum, ILO.

Dr. H. I. S. Thirlway, UNESCO. Dr. Martin Rauterberg, FAO.

Mr. Fournier D'Able, „ Dr. Jean M. Orkney, WHO.

East Pakistan

Mr. M. Islam, Director of Industries. Dr. S. M. Mitra, Dacca University

Dr. Nazir Ahmad, Dy. Director of Fisheries. Dr. A. M. Chaudhury, „

Dr. M. Ishaque, Mycologist, E. Bengal. Dr. K. Ahmad, „

Mr. A. F. M. Abdul Haq, A. D. P. I. Dr. Mafizuddin Ahmad, „

Mr. Alauddin Ahmad, Veterinary College. Mr. M. Innas Ali, „

Mr. S. M. Najmul Haq, Engineering College. Dr. M.M.Hap, P.A.H.R.I. Comilla.

Karachi

Mr. B. A. Khan, Education Advisor, Ministry of Commerce and Education,	Karahci.
Dr. S. Siddiqui, Director, Council of Scientific and Industrial Research,	„
Dr. Nzeer Ahmad, Technical Secretary, Ministry of Industries,	„
Dr. H. K. Gori, Deputy Secretary, „ „	„
Dr. Daud Ali, Department of Industries,	„
Mr. T. H. Hashmi, Assistant Consulting Engineer (Roads)	„
Dr. S. D. Chaudhry, Director, Pakistan Central Jute Committee,	„
Mr. Mohsin Ali, Chairman, Central Engineering Authority,	„
Mr. A. F. Qureshi, Deputy Director, „ „ „	„
Mr. M. Qasim Siddiqui, C. E. Authority	„
Mr. M. Najamuddin, Deputy Surveyer General,	„
Mr. A. R. Qureshi, Assistant „ „	„
Mr. A. Ahad, Officer-in-Charge, Central Testing and Standard Laboratories	„
Mr. M. Z. Khan, „ „ „	„
Dr. M. Tufail Chaudhury, Assistant Director, „ „	„
Mr. S. A. Aziz, Research Engineer, Deptt. of Supply & Development,	„
Mr. Ghulam Jeelani, Station Engineer, Radio Pakistan,	„
Major Aftab Hasan, Principal, Urdu College,	„
Saiyed Shamim Ahmad, Chemistry Department, Karachi University,	„
George Antonoff, „ „ „ „	„
Sayeed Akhtar, „ „ „ „	„
Sulaiman Kerawala, Chairman, Deptt. of Mathematics, „ „	„
Dr. Ahmad Ali Anwar, „ Botany, „ „	„
M. Khalil Khan, Meteorological, „ „ „	„
Syed Mujtaba Karim, Head, „ Physics, „ „	„
Syed Hamid Muhammad, „ Zoology, „ „	„
Dr. M. Afzal Hussain Qadri. „ „ „ „	„
Mr. M. A. Aziz, Army Stores Laboratory,	„
Rao Muhammad Yamin Khan, „	„
Syed M. Ahmid Ali, The Standard Vaccum Oil Company,	„
Dr. (Mrs.) B. B. Quraishi, Central Government College for Women	„
Mr. S. W. H. Razvi, Vetrinary Offices, Bunder Road.	„
Abdul Hameed Khan, Pakistan Central Cotton Committee	„
Mr. Y. S. Ahmad, Inspector General of Forests,	„
Mr. Muhammad, Rahmatullah Pakistan Meteorological Service,	„
Mr. Tajammtl H. Hashmi Asstt. Constulting Engineer, Govt. of Pakistan	„
Mr. Najam-ud-Din Aziz, Biology Department, D.J.S. Govt Science College,	„

Dr. R. A. Khan,	Ministry of Communications & Transport,	Karachi
Dr. A. G. Khan,	Director, Karachi Supply Corporation,	"
Mr. J. Jones,	Managing Director, National Gas and Oil Engine Coy.,	"
Mr. Najam-ud-Din Aziz,	Biology Department, D.J.S. Govt. Science Collegè,	"

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Dr. S. F. Hassan,	Mr. S. S. Haque,
Dr. A. Anwar,	Mr. M. A. Mehkari,
Mr. S. Akbar,	Mr. M. A. Siddiqui,
Mr. Hamid Ali,	Mr. Muhammad Hasan,
Mr. S. A. R. Hashmi,	

Baluchistan

Dr. H. Crookshank,	Director, Geological Survey of Pakistan,	Quetta.
Dr. M. H. Khan,	Geologist, " " "	"
Mr. S. H. Gowher,	" " "	"
Mr. Mumtaz-ud-Din,	Assistant Geologist, " "	"
Mr. A. Wahid,	Assistant Chemist, " "	"
Mr. S. A. Tahir,	Geophysical Research Institute	"
Mr. S. I. Rasool,	" " "	"
Mr. Abdul Latif,	" " "	"
Mr. Moid-ud-din Ahmad,	" " "	"
Agha Ahmad Husain,	Government College,	"

Sind

Mr. Nasir Raza Khan,	Department of Zoology, Govt. College,	Hyderabad.
Mr. S. W. Saeed,	Department of Biology, " "	"

N. W. F. P.

DEPARTMENT OF AGRICULTURE

T. C. Miller,	Director General,	
Fazlur Rahim Khan,	Director,	Fazal Dad Khan, Entomologist,
Abdul Aziz Khan,	Agri. Chemist,	Muhammad Sarwar Khan, Mycologist,
Mir Aslam Khan,	Statistician,	Maruf Shah Roghani, Fruit Technologist,
Mian Said Khan,	Horticulturist,	Abdul Mannan Khan, Entomologist,
Syed Badshah,	Economic Botanist	Mian Obedullah Jan, Sugarcane Specialist.
Prof. A. H. Alawi,	Peshawar University,	Peshawar.
Prof. Mirza Anwar Beg	" "	"
M. Ziauddin	Islamia College,	"
Dr. Muhammad Jamil,	Pakistan Animal Husbandry Research Institute,	"
Amanullah Khan	Sardar Garhi, P. O. Tarnab Farm,	"
Dr. M. S. Namus,	3, Saddar Road,	"
Syed Asad Ali Anvery,	Director, Pak. Forest College, & Research Instt.	Abbottabad,
Ikram Ilahi Chaudhri,	Dy. Director, Botanical Survey of Medicinal Plants,	"
Muhammad Bazlur Rahman,	Chemist, Forest Research Institute,	"
Mr. Mom-ud-Din,	Lawrence College, Ghora Gali,	Murree Hills.
Mr. Masud Hussain,	" " "	"
Abdul Qadeer Beg,	" " "	"

Punjab

DEPARTMENT OF AGRICULTURE

Malik Amanat Khan, Director,	Lt. Comdr. Abdul Latif, Entomologist,
A. W. Chaudhry, Principal, Agri. College,	Mr. Majid Hasan Khan, Agri. Engineer,
Khan Sardar Khan, Cereal Botanist,	Mr. N. D. Yousaf, Sugarcane Botanist,
Ch. Zafar Alam, Oilseeds „	Khan Abdul Wahab Khan, Agri. Chemist
Dr. Abdus Sattar, Plant Pathologist,	Ch. Abdul Rashid Khan, Veg. Botanist.
Agha G. D. Ahmad, Professor of Botany,	S. Sadiq Ali, Fruit Specialist,

DEPARTMENT OF ANIMAL HUSBANDRY

S. M. A. Shah, Director,	Dr. S.D. Ahmad. Principal, Vet. College ,
Khan A. Q. Khan, Deputy Director,	Mr. S. R. Hassan
Mr. M. M. Sarwar. Helminthologist,	Dr. M. Abdussalam,
Sh. Mumtaz Husain, Dairy Officer,	Ch. Muhammad Yaqub,
Mr. S. Z. Kerim, Dairy Surveyor.	Major Munir Ahmad,
Ashiq Husain, Disease Investigation Officer	Mr. Abdul Salam Akhtar,
Mr. Abdul Hamid,	Mr. Muhammad Shafi Khan,
Mr. Ghulam Mohyuddin Siddiqi,	Mr. Tassadaq Husain.

UNIVERSITY OF THE PANJAB

Dr. Hamid Khan Bhatti, Zoology Deptt.	Dr. M. Zia-ud-Din, Statistic Institute
Dr. Muzaffar Ahmad. „ „	M. Moinuddin Siddiqui, „ „
K. Zia-ud-Din, „ „	Muhammad Iqbal, „ „
Abu Bakr, „ „	Inam-ul Haq, „ „
Sher Ahmad Lodhi. Botany Deptt.	Asghar Ali, „ „
Abdul Hamid Shelkh, „ „	Elias Dubash, Chemistry Institute.
Abdul Rashid Muhajir, „ „	Ather Husain, „ „
Dr. Muhammad Amin, Pharmacy Deptt.	M.S.F.A. Abidi, „ „
Muhammad Salahuddin, „ „	K.A. Moinuddin Khan, „ „
Miss Maryam K. Elahi, Geography Deptt.	Qamar Din Ansari, „ „
Khalilullah Kureishy, „ „	A. Waheed Khan „ „
Owaisul Mustafa Qarni, Physics Deptt.	M. Ata-ur Rahman, „ „

LAHORE COLLEGES

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Dr. Ahmad Ali Quraishi, Govt. College,	Dr. Majida Mehtab, „ „ „
Dr. M. Sharif, „ „	F. D. Anjum Roomani, D. S. College,
Dr. M.A. Pirzada, K.E. Medical College,	Mohammad Maqbool Ilahi, T. I. College,
Dr. G.M.K. Baloch, F. J. Medical College,	Mohammad Aslam, Islamia College,
Dr. Jabbar Sherwani, Engineering College,	M. Abdul Rehman, M. A. O. College.
Dr. M. Salim, College of Dentistry,	Dr. John H. Martin, F. C. College,
M. F. Qureshi, Zamindar College,	Gujrat.
Dr. Noor Husain, Municipal Medical Officer of Health,	Sialkote.
Major S. M. K. Wasti, Mayo Hospital,	Lahore.
Dr. Shabbir Hasan, Provincial Tuberculosis Officer,	„
Mr. Abdul Majid Qureshi, Director, Punjab Forensic Laboratory, C.I.D.	„
Dr. Allah Bakhsh, Instt. of Hygiene and Preventive Medicine,	„

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A. M. Chowdhry,	Asstt. Director (Inspection)	"
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Emaduddin Ahmad,	Officer I/c. Seismological Observatory,	"
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Bashir Ahmad,	Divisional Forest Officer, " "	"
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Qazi Jamaluddin Ahmad.	Sughra Khanam	

OPENING PROCEEDINGS

ADDRESS OF WELCOME

BY

Mr. S. M. SHARIF,

Director of Public Instruction, Punjab; Chairman of the Reception Committee.

YOUR EXCELLENCY, MR. PRESIDENT, LADIES AND GENTLEMEN,

As Chairman of the Fifth Annual Conference of the Pakistan Association for the Advancement of Science, it is my privilege to extend to all those who are present here today—members, delegates and visitors—a most cordial welcome. We are fortunate in having among us a number of distinguished scientists from abroad; they have come from America, Great Britain, Egypt, India, Iran and Turkey. We have also among us representatives of the United Nations Educational, Scientific and Cultural Organisation, the World Health Organisation and the International Labour Organisation, three of the United Nations specialised agencies whose object is to promote human knowledge and welfare. They are the leading scientists of their countries and some of them have already won world fame. Their presence here today is evidence of the interest which their countries or organisations are taking in our problems. We deeply appreciate this gesture of goodwill and we are grateful to them for having travelled long distances to participate in this Conference. We have also here today the best of Pakistan's talent, who represent our past achievements and future hopes. We welcome them all, most heartily.

The first session of the Pakistan Science Association, which marked the birth of the Association, was held in Lahore in 1949. This is the second session to be held here and we greatly value this privilege. This Province was somewhat late in taking to western education, but once the initial indifference was over, progress was most rapid. Science, in many ways the most welcome benefit of the western education, made special appeal to us. We built laboratories and research institutes. Our scholars flocked to famous British and Continental Universities for higher scientific studies. On return, they helped to build high traditions of learning and scholarship in several important Sciences. I would like to take this opportunity to pay my tribute to the many devoted men of science whose work we shall always remember with gratitude. Some of them have left this country, others

are still with us. I shall mention a few names: Colonel J. Stevenson, Professor Hemmy, Dr. George Mathai, Sir Shanti Sarup Bhatnagar, Mian Afzal Husain, Dr. Nazir Ahmad and Dr. Bashir Ahmad, the President of this Conference. The traditions set by these eminent scientists are being carried on by a band of workers, some of whom have already received international prominence.

Panjab also possesses some good laboratories and research institutes. The Panjab University and the Government College, Lahore, between them have well equipped laboratories for Zoology, Biology, Physics, Chemistry, Psychology, Geography and Geology. An institute for Statistics was inaugurated the other day and we may soon have similar institutes in other subjects.

With these traditions, extensive laboratories and promising talent, we can justifiably feel proud that the Pakistan Association for the Advancement of Science should have selected this Province as the venue of its annual conference for the second time during the last four years.

While the post-graduate Departments of the Panjab University at Lahore had achieved a position of eminence in the undivided India, the general educational system followed a predominantly literary bias. The study of science was relegated to a secondary position in the school curricula and very few mofussil colleges offered courses in higher science. I am happy to state that during the last five years, there has been a welcome shift from literary to scientific bias. Science has received more and more assistance from Government and educational authorities. Not only has more money been found for science, but new methods and new ideas for its teaching have also been tried. Special officers have been appointed at the Headquarters and in the Divisional offices of the Education Department to promote the teaching of science and special pay has been sanctioned for science teachers in schools in addition to their normal scale.

At the collegiate stage also, there is the same evidence of special attention to science. Now Science Departments have been opened in the mofussil colleges and the existing departments of Lahore colleges have been suitably strengthened. Special grants have been given to Government and non-Government colleges for science equipment. In particular, women colleges have been encouraged to open up science departments and special scholarships have been sanctioned to attract women students to scientific studies. A High Tension Laboratory has been built at the Government College, Lahore, to promote nuclear research and the Panjab University has been given increased grants to improve its existing facilities for science teaching. Scientists are being sent abroad regularly for higher studies.

The emphasis on scientific education is encouraging and we hope it will be maintained. But as education expands, we must ensure that adequate standards

of efficiency are maintained. There is, however, a serious limiting factor, the insufficiency of staff both in numbers and attainments. It is, therefore, essential that the training of personnel should be co-related to our expanding requirements.

Our aim should be to make the teaching standards in our University and research institutes comparable to the best in the world so that their products can command respect in the councils of the famous Universities abroad. For this purpose, we have to make a bigger effort. We want more and better equipped laboratories, more libraries, but above all, a body of highly trained and competent teachers and research workers in ever increasing numbers to run our expanding institutions. On the ability and competence of the teaching and research staff will depend our future scientific progress and I hope that this Conference will be able to suggest ways and means of improving the quality and attainments of the existing and future personnel.

There is a general impression that the study of Science needs special encouragement for the sake of economic development only. This is an erroneous impression. We need it also for the benefits which Science education confers on individual character, in terms of habits of strenuous work and of clear and rational thinking. Science education, therefore, is also a means of general education, to that training of mind which has its relevance in almost any human occupation.

I am a layman, not having had any formal training in any one of the well-known Sciences, but there is one thing which I would like to say on this occasion. This is regarding the distinction between natural and social Sciences, a distinction which is now well-established. I do not know how the distinction can be defined but perhaps natural sciences are concerned with phenomena in external nature, phenomena which strike the human mind as external to itself. Social Sciences are concerned with the facts and phenomena determined in important ways by the actions and reactions of human individuals and human groups. It is difficult to say which of these two groups of Sciences is the more important—natural or social? Western science, until now, has given more attention to natural than to social sciences. It even seems sorry that it did so. The outlook of our own Science Association, revealed in its programmes and activities, regards natural and social sciences as equally important. I wish to point out this distinction however, with another purpose. It is this that while we may feel that we are far behind others in our mastery of natural sciences, we need not have any such feeling regarding social sciences. Social sciences depend for their advancement more on ingenuity of ideas than on apparatus and equipment. In fact, the cultural traditions we have inherited give us some advantages over other people in the study of social

facts. Adjustment to present day conditions, needs material advancement and material facilities but it also needs a correct grasp of human motives and human aspirations and of all the complex needs of human society. In the study of these matters our opportunity is as great as our obligation.

It is now my pleasant duty to thank Your Excellency for your presence in our midst and to request you to inaugurate the Fifth Session of the Pakistan Science Conference.

INAUGURATION ADDRESS

BY

HIS EXCELLENCY MR. I. I. CHUNDRIGAR,
Governor, Punjab, Lahore

MR. PRESIDENT, LADIES AND GENTLEMEN :

I consider it a great privilege to inaugurate the Fifth Annual Pakistan Science Conference today.

The Pakistan Association for the Advancement of Science could not find a setting more congenial to the spirit of the Conference than this historic city. Lahore has been through centuries, and is still today, a centre of learning and culture, of creative thought and intellectual enquiry. During the last thirty years, Lahore came to occupy, in the sub-continent, a position of eminence in the domain of scientific research and it is today the biggest centre of scientific activity in Pakistan.

To the organisers of the Conference and to all those who are assembled here today, I extend a warm welcome. In the great tasks that lie ahead of us—tasks of economic, scientific and cultural development—we need international collaboration. It is, therefore, with particular pleasure that I welcome the distinguished visitors from great Britain, Egypt, India and Turkey who are here to give their Pakistani colleagues the benefit of their mature experience and scholarship. I hope that their stay here will be a pleasant one and that they will find collaboration in this Conference of mutual benefit.

Ladies and Gentlemen : Some people think that Science and Religion are incompatible and attribute the comparative backwardness of the Muslims to this inherent conflict. It would be well to remove this impression which is in no way borne out by facts. Islam has never been a barrier to Science and progress, which are synonymous. On the other hand, Islam has always asserted the predominance of reason and consequently of learning above all other manifestations of life. Islam's contribution to scientific progress is well recognised and two of its distinguished savants, Jabir and Avicenna, combined scientific genius with an unshakable belief in Islam. It is now for the Muslim scientists to show to the world that they have an important contribution to make to the growth of scientific knowledge.

It is the second time that this Conference has chosen Lahore as its venue. Four years have passed since you last gathered here, and I am glad to say that during this period the study of Science and its practical application to human

needs has made considerable progress in this Province. The University, the Arts and professional Colleges, the Departments of Agriculture, Education, Engineering and Medicine have all increased the emphasis on scientific knowledge and research. By way of illustration, I may mention the work of some of these departments.

The Chemistry Department of the University, under the able guidance of your President, Dr. Bashir Ahmad, has maintained its reputation for original research and has helped in the solution of a number of industrial problems in which industrialists and manufacturers wanted help. In particular, it has done valuable research in oils, cotton seeds, etc.

The Government College, Lahore, has set up a new nuclear Physics Laboratory and its completion is expected to open new avenues in the field of atomic research. It is my earnest hope that this Laboratory will make useful contribution to scientific progress in this country.

There are other Government laboratories in the Punjab which are doing useful work in their own spheres. There is the Industrial Laboratory, which caters to the needs of industrialists, the Irrigation Research Institute, which is active in solving problems of water flow, river training and structure of materials. The Directorate of Land Reclamation is doing good work in fighting the twin menace of waterlogging and salinity of agricultural land, and the Buildings and Roads Research Laboratory has been recently expanded to deal adequately with the problems relating to the construction and maintenance of roads in this Province.

The emphasis laid by the Punjab Education Department on the promotion of scientific bias in school education is particularly commendable.

I am happy to state that my Government is fully conscious of the importance of science and has been devoting increasingly larger funds for the expansion of scientific education at all levels and for the promotion of scientific research.

While this progress is encouraging, a great deal still remains to be done. I hope that this Conference will be able to stimulate further activity in the various branches of scientific knowledge.

I am aware of the fact that the primary needs of a scientist, his indispensable tools, are an adequately equipped laboratory and an up-to-date library. My Government is anxious to do all that is possible to facilitate the work of scientists in these essential respects. Government alone cannot, however, finance all educational activity; its efforts must be supplemented by public philanthropy. I should, therefore, like to take this opportunity to appeal to the public to contribute generously to schemes calculated to promote knowledge and scientific research. I am happy to announce a munificent donation of rupees one lac by Sh. Naseer Ahmad of the Colony Textile Mills, Multan, for a Science Auditorium

and Library. I deeply appreciate this act of generosity and I commend his example to others in the confident hope that they will also make similar gifts in the cause of education, science and culture.

Ladies and Gentlemen : It is scarcely necessary for me to remind the scientists of their responsibilities in this atomic age. These have increased in proportion to the powers they now wield. Never in human history have scientists been endowed with more fateful potentialities for good or evil. On the one hand, they have widened the range of human knowledge enormously and have placed within our reach a vision of life free from all remediable distress. On the other, they have also created powerful instruments of destruction. The future of mankind will depend largely on how the scientists discharge their responsibility. It is my sincere hope and the hope of all of us that they will not allow their human obligations to be submerged by purely professional considerations and that they will use their talents mainly for the welfare of humanity.

Pakistan is an under-developed country ; at its inception, it received the legacy of mass illiteracy, poverty and disease. Agriculture is the main occupation of the people, but its methods, too often, are primitive. Industry is yet in an incipient stage. But, fortunately, Pakistan has great potentialities—a sturdy and virile people and immense natural resources. What it needs is a large army of trained personnel ; scientists, engineers and technicians, to develop its resources. It needs men to modernise its agriculture, to improve national health, to establish big industry and to exploit the mineral resources of the country. It is for you, the scientists assembled here, to examine these problems and to suggest practical measures for their solution. I am confident that during the next few days these problems will receive your careful thought and consideration.

International collaboration is now recognised as the most effective means of promoting scientific knowledge and research. It enables the resources and devotion of the whole mass of research workers and experts to be pooled for the benefit of all. Free exchange of information, quick dissemination of knowledge, and personal contacts have materially contributed to scientific advancement. Periodic conferences at national and international levels have been most fruitful and I am confident that this Conference, with the help of our distinguished foreign scientists, will produce equally good results, and that it will be able to offer practical suggestions for the solution of our immediate problems. I further hope that the association of our scientists with those from abroad will help to promote mutual understanding and goodwill which are so essential for the welfare of mankind.

In this spirit of hope for our national development and faith in international goodwill, I declare this Conference open.

GOODWILL MESSAGES

Sir Edward Appleton, President, British Association for the Advancement of Science, London.

On the occasion of the Annual Conference of the Pakistan Association for the Advancement of Science at Lahore, the Officers and Council of the British Association send the cordial greetings and sincere good wishes for a successful session.

The Council of the British Association deeply appreciate the generosity which has made it possible for two representatives to attend the meeting as guests. Sir Harold Hartley and Dr. George Taylor are leaving Britain with a lively expectation of taking part in an annual event of great importance in the life of Pakistan and in the world of science generally. We have all watched with sympathetic interest the growth of the Pakistan Association, which was founded with courage and foresight in times of great difficulty. We sincerely hope that it will advance from strength to strength, and that the friendly ties which already unite our two Associations will help to advance the work to which both bodies are committed.

We shall look forward to receiving reports of the Fifth Annual Pakistan Science Conference and wish Godspeed to all your deliberations.

Professor A. Ghaffari, University of Teheran.

It gives me great pleasure to be here today to attend the Fifth Annual Pakistan Association for the Advancement of Science Conference as the delegate of the University of Teheran. I would like to thank you on behalf of my University for the kind invitation extended to Teheran University which has enabled me to come here. This is the fifth conference of your association and I hope it will be the beginning of an era of closer contact in scientific affairs between Iran and Pakistan.

To you, Mr. President, as the head of an Association with a record of five years of eminent service to science, I would like to express my personal appreciation of all the arrangements which have made it possible for me to attend this conference in your famous and historic city of Lahore. I am confident that the atmosphere of understanding in which the plans for meetings have matured, will be maintained during our deliberations. It is evident that many problems need closer consideration and these include the fuller use of science for the benefit of mankind, the improvement of scientific communications and other questions relating to the

organization of science between the nations, and the machinery of international scientific cooperation. Nevertheless, I believe that nothing can take the place of personal contacts. However clearly a man may write, it is the spoken word which has a directness of appeal which cannot be achieved in any other medium.

I may say from personal experience of international scientific gatherings that it has often been the unrecorded proceedings and unprogrammed discussions which have proved the most helpful.

I, therefore, believe that this conference is of the utmost value in affording the opportunity for discussion of the topics of such overwhelming importance for the future of the civilized world.

H. E. Malik Feroz Khan Noon, Governor, East Bengal, Dacca.

I offer a warm welcome to the great and eminent scientists from many countries of the world who have honoured us by attending the Fifth Annual All-Pakistan Science Conference in Lahore. I consider it a great privilege for the country to have these learned men with us. A young country like ours has to depend for advanced scientific knowledge and education on the achievements of the older and more advanced countries if we have to make a rapid development. This visit of our honoured guests through exchange of ideas and discussions will greatly benefit our own scientists and thus be a cause of an incentive for further scientific research work inside Pakistan.

We in this country realise the importance of scientific research for the benefit of our growing industry and for the other spheres of our national life. Every country has its special problems to tackle and it is naturally our own scientists on whom the initial burden must fall, but the advice, guidance and active assistance of scientists abroad can be of great help to us. In western countries and in America scientific research institutes are started usually by large and rich firms which do not exist in this country. Per force Government has to step into this breach and I am confident that as time goes on, the setting up of research institutes in Pakistan will receive the support it deserves at the hands of our Government. On the scientists will depend the future prosperity of Pakistan. It is the scientists alone who can make the earth and nature yield fruits for the use of man. I wish the Conference all success.

H. E. Khwaja Shahabuddin, Governor, N.-W.F.P., Peshawar.

Science is a quest for truth, a yearning for knowledge of the ultimate reality of things. Religion is also a quest for truth but its province is distinguished from that of Science. Whereas Science seeks to give answer to question how, Religion seeks to answer questions like why, wherefore and

whence. The two are, in fact, facets of the same picture. Iqbal said that a nation, which cuts itself adrift from Religion, cannot survive. It may be said with greater force today that a nation which turns its back on Science cannot survive in this atomic age. In the modern world, therefore, Science should be the hand-maid of Religion and both should aid one another in reconciling intellect with the heart and spirit with matter to produce a better world. The need for instilling a spirit of enquiry and cultivating a scientific attitude towards things in our generation, with the ultimate end of bringing Science to the service of our masses, of removing the fear from want and disease lifting them from the morass of ignorance and giving them a better world to live in, cannot be too strongly emphasized. It was with these objectives and ideals that the Pakistan Science Conference was inaugurated 5 years ago, in which distinguished Scientists from all over the world have participated since then. It gives me great pleasure that the fifth session of the Conference is being held in Lahore and I send to the organisers of the Conference and participants therein my heartiest good wishes for its success and pray that it may achieve the objectives which it has set before itself.

The Hon'ble Khan Abdul Qaiyyun Khan, Chief Minister, N.-W.F.P., Peshawar.

I send my heartiest greetings and good wishes to all participants in the Fifth Annual All-Pakistan Science Conference.

The pooling of ideas and the study of new methods of approach to those problems which beset mankind in the realm of Science cannot but be of inestimable benefit to the people of our country, as well as all other countries of the World.

I am particularly gratified to realise the encouragement which the Conference will offer to our younger generation of Pakistani Scientists, and specially to those still in the making in our Universities, who will have the inspiration of contact with some of the greatest figures of our day, and from whom we are expecting so much in the years ahead.

General Muhammad Ayyub Khan, Commander-in-Chief Pakistan Army.

I highly appreciate the invitation extended by the organisers of the Fifth Annual Pakistan Science Conference to the Army for participation in their deliberations.

In the modern age, the Army has to employ and handle a wide range of scientific equipment which is evolved from the specialised branches of science. The Army is thus keenly interested in scientific development and its practical application in Pakistan.

I wish the Conference all success.

PROCEEDINGS
OF THE
SIXTH
PAKISTAN SCIENCE CONFERENCE
KARACHI, 1954

PART I
OFFICIAL MATTERS
AND
OPENING PROCEEDINGS



PUBLISHED BY
PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
LAHORE

P R O C E E D I N G S
OF THE
S I X T H
PAKISTAN SCIENCE CONFERENCE
KARACHI, 1954

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PART I:—Official Matters and Opening Proceedings

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C O U N C I L
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1954

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President : K. B. Dr. M. S. Mahmood, M.B., B.S., L.R.C.P., M.R.C.S., D.O.M.S.,
D.T.M. & H., Chief Medical and Health Officer, N.W.R., Lahore.

Secretary : Dr. Abdul Hameed, M.B.B.S., D.P.H., D.T.M., Divisional Medical Officer,
N.W.R., Karachi.

PHYSICS : MATHEMATICS : STATISTICS : ASTRONOMY : METEOROLOGY

President : Dr. Abdus Salam, M.A. (Pb.), B.A. (Hon.), Ph.D. (Cantab.), Professor
of Mathematics, (on deputation to St. John College, Cambridge).

Secretary : Mr. S. N. Naqvi, M.Sc., Director, Meteorological Department, Karachi.

SECTIONAL COMMITTEES

A.—AGRICULTURE : ANIMAL HUSBANDRY AND FORESTRY

Dr. Khan A. Rahman, Director of Agriculture, Punjab, Lahore, (*President*).
Mr. Y. S. Ahmad, Inspector General of Forests, Government of Pakistan, Karachi.
Ch. Muhammad Afzal, Agricultural Development Commissioner, Karachi,
Dr. S. Hidayetullah, Director of Agriculture, East Bengal, Dacca.
Sir William Roberts, C.I.E., B.C.G.A., Civil Lines, Khanewal.
Dr. Abdus Sattar, Assistant Director of Agriculture, Punjab, Lahore.
Mr. Nisar Ahmad Khan, Deputy Director of Animal Husbandry, East Bengal, Dacca.
Mr. F. U. Ahmad, Principal, Agricultural Institute, East Bengal, Dacca.
Dr. Nazir Ahmad, Director of Fisheries, East Pakistan, Comilla.
K.S. Mian Allah Bakhsh, Pir Mahal, District Lyallpur.
Prof. A. W. Chaudhury, Principal, Agricultural College, Lyallpur.
Malik Amanat Khan, Additional Director of Agriculture, Punjab, Lahore.
Mr. Fazal-i-Rahim Khan, Director of Agriculture, N.W.F.P., Peshawar, (*Secretary*).

B.—BIOLOGY : ZOOLOGY : BOTANY AND ENTOMOLOGY

Dr. Abdus Sattar, Assistant Director of Agriculture Punjab, Lahore, (*President*).
Dr. S. Hidayetullah, Director of Agriculture, East Bengal, Dacca.
Dr. M. Sharif, Head, Department of Biology, Government College, Lahore.
Dr. Hamid Khan Bhatti, Head, Department of Zoology, Panjab University.
Dr. Muzaffar Ahmad, Department of Zoology, Panjab University, Lahore.
Dr. Nazir Ahmad, Director of Fisheries, East Pakistan, Comilla.
Mr. Sher Ahmad Lodhi, Professor of Botany, Government College, Lahore.
Dr. M. A. H. Qadri, Dean, Faculty of Science, Karachi University.
Dr. M. Rahimullah Qureshi, Director of Fisheries, Government of Pakistan, Karachi.
Dr. Nazir Ahmad, Principal, Government College, Jhang.
Lt. Commander Agha A. Latif, Entomologist, Agricultural College, Lyallpur.
Ch. Zafar Alam, Oil Seeds Botanist, Agricultural College, Lyallpur.
Dr. G. P. Mojumdar, Head, Department of Biology, Dacca University.
Dr. A. Alim, Economic Botanist (Cereals), East Bengal Government, Dacca.
Dr. Abdul Hamid, Forest Botanist, Pakistan Forest Research Institute, Abbottabad.
Dr. Sultan Ahmad, Professor of Botany, Government College, Lahore, (*Secretary*).

C.—CHEMISTRY : APPLIED CHEMISTRY

- Dr. A. G. Asghar, Director of Land Reclamation, Punjab, Lahore, (*President*).
 Dr. Ali Ahmad, Director, P. I. D. C., Karachi.
 Dr. M. O. Ghani, Head, Department of Soil Sciences, Dacca University.
 Dr. Karimullah, Deputy Director of Industries, Punjab, Lahore.
 Dr. S. D. Muzaffar, Scientific Liaison Officer for Pakistan, U.K.
 Dr. M. Qudrat-i-Khuda, Scientific Adviser to Ministry of Defence, Govt. of Pakistan.
 Dr. M. I. D. Chughtai, Department of Chemistry, Panjab University, Lahore.
 Dr. Badar-ud-Din, Department of Chemistry, Panjab University, Lahore.
 Professor Mirza Anwer Beg, Government Islamia College, Peshawar.
 Dr. Niaz Ahmad, Director, Institute of Chemical Technology, Panjab University.
 Dr. M. H. Khundkar, Reader in Chemistry, Dacca University.
 Khwaja Salahuddin, Institute of Chemical Technology, Panjab University, Lahore.
 Dr. Bashir Ahmad, Vice Chancellor, Panjab University, Lahore.
 Dr. Salimuzzaman Siddiqui, Director, Pakistan C. S. I. R., Karachi.
 Dr. S. A. Warsi, Senior Research Officer, C.S.I.R., Karachi, (*Secretary*).
-

D.—EDUCATION : SOCIOLOGY : PSYCHOLOGY

- Dr. Mahmood Husain, Professor of History, Karachi University, (*President*).
 Professor B. A. Hashmi, Principal, Central Training College, Lahore.
 Dr. S. M. Hosain, Vice Chancellor, University of Dacca.
 Professor Q. M. Aslam, Head, Department of Psychology, Govt. College, Lahore.
 Dr. C. H. Rice, 156, Fifth Avenue, New York City, U.S.A.
 Mr. A. H. Alawi, Chairman, Department of Education, Peshawar University.
 Mrs. Saeeda Malik, Principal, Lady MacLagan College, Lahore.
 Mrs. F. Zoha, Principal, Eden's Girls College, Dacca.
 Prof. Siraj-ud-din, Principal, Government College, Lahore.
 Khalifa Abdul Hakim, Director, Islamic Research Institute, Lahore.
 Mr. S. M. Sharif, Director of Public Instruction, Punjab, Lahore.
 Hon'ble Justice S. A. Rahman, 47, Lawrence Road, Lahore.
 Dr. Mumtaz-ud-Din Ahmad, Officer on Special Duty, Education Division, Karachi.
 Professor M. M. Sharif, Principal, Islamia College, Lahore.
 Dr. G. Jilani, Head, Department of Philosophy and Psychology, Dacca University,
 (*Secretary*).
-

E.—ENGINEERING : IRRIGATION : HYDEL POWER : HYDRAULICS : Etc

- Mr. M. Azam Khan, Chief Engineer, P.W.D., Irrigation, Punjab, (*President*).
 Mr. Mohsin Ali, Chairman, Central Engineering Authority, Karachi.
 Khwaja M. Azeemuddin, Chief Engineer, P.W.D., Irrigation, East Bengal, Dacca.
 Pir Muhammad Ibrahim, Chief Engineer, P.W.D., Punjab, Lahore.
 K. B. Sheikh M. A. Hamid, Chief Engineer, P.W.D., Punjab, Lahore.
 Mr. Hakim Ali, Principal, Punjab College of Engineering, Lahore.
 Dr. Nazir Ahmad, Physicist, Irrigation Research Institute, Punjab, Lahore.
 Dr. Mir Mushtaq Ahmad, Hydraulic Officer, Irrigation Research Institute, Lahore.
 Mian Nazir Ahmad Jiabaji, Executive Engineer, Mandi Burewala.
 Col. Mohammad Iftikharuddin Mufti, 64 Cunningham Road, Lahore Cantt.
 Mr. C. M. Latif, Batala Engineering Co., Lahore.
 Mr. T. H. Mathewman, Principal, Dacca Engineering College, Dacca.
 Mir Bashir Khan, Chief Engineer, N.W.F.P., Peshawar.
 Mr. M. I. Haquani, Chief Development Officer, P.I.D.C., Karachi.
 Mr. A. F. Qureshi, Deputy Director, C. E. Authority, Karachi, (*Secretary*).
-

F.—GEOLOGY, GEOGRAPHY AND ANTHROPOLOGY

- Dr. Nafees Ahmad, Chairman, Department of Geography, Dacca University, (*President*).
 Dr. H. Crookshank, Director, Geological Survey of Pakistan, Quetta.
 Dr. K. S. Ahmad, Chairman, Department of Geography, Panjab University.
 Professor O. A. Broch, Head, Department of Mineralogy, Panjab University.
 Mr. Asrarullah, Department of Geology, Panjab University, Lahore.
 Mr. Mohammad Ashraf Khan Durrani, Deptt. of Geography, Peshawar University.
 Dr. (Miss) Mariam Karam Ilahi, Department of Geography, Panjab University.
 Dr. Maneck B Pithawala, Professor of Geography, Karachi University.
 Mr. Aziz Ahmad Sheikh, Head, Department of Geography, Govt. College, Lahore.
 Dr. Abdul Hamid Khan, H.M.P.S. "Bahadur," Royal Pakistan Navy, Karachi.
 Mr. A. M. Patel, Department of Geography, Dacca University.
 Mr. Abdul Haye, Head, Department of Geography, Islamia College, Lahore.
 Professor Mirza Anwer Beg, Government Islamia College, Peshawar.
 Mr. Khalilullah Qureshi, Department of Geography, Panjab University, Lahore.
 Mr. Shams-us-Zoha, Lecturer in Geography, Government College, Quetta.
 Mr. S. Z. Ahsan, Department of Geography, Karachi University, (*Secretary*).
-

G.—MEDICINE : VETERINARY SCIENCES

K.B. Dr. M. S. Mahmood, Chief Medical Officer, N.W.R., Lahore, (*President*).
 Dr. G.M.K. Baloch, Professor of Medicine, F. J. Medical College for Women, Lahore.
 Dr. M. A. Pirzada, K. E. Medical College, Lahore.
 K. B. Dr. Mohammad Yusuf, 5, Durand Road, Lahore.
 Colonel S.M.K. Mallick, Principal, Dow Medical College, Karachi.
 Dr. M. Abdussalam, Punjab Veterinary College, Lahore.
 Dr. S. M. K. Wasti, K. E. Medical College, Lahore.
 Dr. A. Wahid, Professor of Medicine, Medical College, Dacca.
 Dr. Mushtaq Hasan, Dow Medical College, Karachi.
 Dr. (Mrs.) H. Sayeed, Medical College, Dacca.
 Dr. Bilqees Fatima, Professor of Gynaecology, F. J. Medical College, Lahore.
 Dr. M. J. Bhutta, Principal, Nishtar Medical College, Multan.
 Dr. S. M. Ali, Principal, Medical College, Dacca.
 Colonel M. Saeed, Jinnah Central Hospital, Karachi.
 Colonel M. H. Shah, Jinnah Central Hospital, Karachi.
 Dr. Abdul Hameed, D.M.O., N.W.R., Karachi, (*Secretary*).

H.—PHYSICS : MATHEMATICS : STATISTICS : ASTRONOMY AND METEOROLOGY

Professor Abdus Salam, Head, Department of Mathematics, Panjab University,
 (*President*).
 Dr. M. Zia-ud-Din, Director, Institute of Statistics, Panjab University, Lahore.
 Late Mr. Mohammad Aslam, Director of Meteorological Department, Karachi.
 Dr. M. Razi-ud-Din Siddiqi, Vice Chancellor, Peshawar University.
 Dr. Abdul Haque, Professor of Physics, Rajshahi University, Rajshahi.
 Dr. Nazir Ahmad, Chairman, Pakistan Tariff Commission, Karachi.
 Mr. A. R. Nasir, Assistant Professor of Mathematics, Engineering College, Lahore.
 Dr. A. M. Chaudhury, Reader in Physics, Dacca University.
 Dr. A. B. Pal, Department of Physics, Panjab University, Lahore.
 Dr. A. M. Mian, Head, Department of Physics, Panjab University, Lahore.
 Dr. S. M. Mitra, Professor of Physics, Dacca University, Dacca.
 Mr. M. Sulaiman Kerawala, Head, Department of Mathematics, Karachi University.
 Dr. M. Ishaque, Principal Education Officer, Pakistan Military Academy, Kakul.
 Prof. A. L. Shaikh, Principal, D. J. Sind Government Science College, Karachi.
 Mr. S. N. Naqvi, Director, Meteorological Department, Karachi, (*Secretary*).

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SUB-COMMITTEES

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Dr. Mazhar-ul-Haque, Dow Medical College, Karachi.

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Joint Secretary :

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Members :

Mr. Y. S. Ahmad, Inspector-General, Forests, Pakistan Secretariat, Karachi.
Dr. Taskhir Ahmad, Director, Department of Plant Protection, Karachi.
Dr. M. Rahimullah Qureshi, Director, Department of Fisheries, Karachi.
Prof. L. G. G. Warne, Department of Botany, University of Karachi.
Dr. S. M. Karim, Professor of Physics, University of Karachi
Mr. S. M. Kerawalla, Department of Mathematics, University of Karachi.
Major Aftab Hasan, Principal, Urdu College, Karachi.
Mr. I. Y. Suleman, Principal, S. T. College, Karachi.
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Secretary :

Major Aftab Hasan, Principal, Urdu College, Karachi.

Joint Secretary :

Mr. Ismail Siddiqi, Department of Geography, University of Karachi.

Members :

Mr. Imtiaz Mohammad Khan, Director of Education, Karachi.
Mr. H. H. Zaidi, Professor of Physics, Sind Muslim College, Karachi.
Mr. Nasir-ud-din, Zoology Deptt. D.J.S. Science College, Karachi.
Mr. Kohati, Sind Muslim College, Karachi.
Mr. Iftikhar Ali, Sind Government Commerce College, Karachi.

PUBLICATION COMMITTEE

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Mr. S. Mohammad Ikram, Joint Secretary, Ministry of Information, Karachi.

Secretary :

Mr. Aziz Ahmad, Director of Publicity, Pakistan Secretariat, Karachi.

Joint Secretary :

Mr. Khursheed Husain, Department of Physics, University of Karachi.

Members :

Dr. M. M. Siddiq Husain, Deputy Director, Bureau of Laboratories, Karachi.

Dr. M. Rafiq Khawar, Editor, *Mah-i-Nau*, Karachi.

Dr. Maneck B. Pithawalla, Department of Geography, University of Karachi.

Mr. I. Y. Suleman, Principal S. T. College, Karachi.

Mr. S. M. Jafree, Information Officer, Pakistan Secretariate, Karachi.

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Secretary :

Dr. (Mrs.) B. B. Qureshi Prof. of Zoology, Govt. College for Women, Karachi.

Members :

Mr. Aziz Quraishi, Engineer, Joint Water Board, Karachi.

Professor R. E. Mirza, N.E.D Engineering College, Karachi.

Mr. Abdul Aziz K. Sheikh, Director, Town Planning, Karachi.

Mrs. D'Abreo, St. Joseph's College for Women, Karachi.

Miss Talker, Government S. T. College, Karachi.

Major Qaiser Husain Khan Bakhtiari, Government T. T. College, Karachi.

EXCURSION COMMITTEE

Chairman :

Mr. G. Moinuddin, Chairman, Joint Water Board, Karachi.

Secretary :

Dr. S. Z. Hasanain, Department of Botany, University of Karachi.

Joint Secretary :

Mr. Masoom Ali Tirmizi, Department of Physics, University of Karachi.

Members :

Mr. M. Sifat Ullah Siddiqi, Zoological Survey of Pakistan, Karachi.

Mr. Ghulam Husain Agha, Central Fisheries Department, Karachi.

Mr. Nasiruddin, D.J.S. Government Science College, Karachi.

Mr. Said Akhtar, Department of Chemistry, University of Karachi.

Mr. Abid Husain, Department of Physics, University of Karachi

DONATION COMMITTEE

Chairman :

Dr. A. H. Khan, Director-General, Supply and Development, Karachi.

Secretary :

Dr. I. H. Usmani, Chief Controller of Exports and Imports, Karachi.

Joint Secretary :

Dr. A. A. Anwar, Department of Botany, University of Karachi.

Members :

Dr. Munawar Ali, Dow Medical College, Karachi.

Mr. M. A. Jawwad, 23, Qamar House, Bunder Road, Karachi.

Mr. M. Siddiq Wahab, Mubarak Manzil, Clayton Road, Karachi.

Mr. R. A. M. Henson, Managing Director, Glaxo Laboratories, Karachi.

Mr. Q. M. Fareed, Department of Physics, University of Karachi.

D O N O R S

Mirza Bashir-ud-Din Mahmud Ahmad, Rabwah.

Mr. Muhammad Ali Rangoonwala, Jodia Bazar, Karachi.

Mr. Kasim H.K. Dada, Resident Director, Muhammadi Steamship Co., Karachi.

Sheikh Muhammad Amin, Karachi.

Mr. Shaharyar Irani, Karachi.

Mr. Rustumjee Cowasjee, Karachi.

Mr. Wajid Ali, Managing Director, Ali Automobiles, Karachi.

Mr. Amir Ali Fancy, Pakistan Industries Ltd., West Wharf Road, Karachi.

M/s. Azam Trading Corp., Garikhata, Faiz Muhammad-Fateh Ali Rd., Karachi.

M/s. Consolidated Products, McLeod Road, Karachi.

M/s. Malik & Co., Karachi.

PROGRAMME

Monday, Jan. 18.

11-00 a.m. Recitation from Holy Quran.

Opening Speech by the Retiring President, Dr. Bashir Ahmad.

Welcome Address by the Chairman, Reception Committee, Lt. Col. A.B.A. Haleem.

Inauguration of the Conference by His Excellency Mr. Ghulam Mohammad, Governor General of Pakistan.

Presidential Address by Dr. M. Raziuddin Siddiqi.

Annual Report of the P.A.A.S. by the General Secretary, Dr. Karimullah.

Introduction of foreign delegates and messages of Goodwill.

2-30 p.m. Lecture by Dr. S. S. Bhatnagar.

4-15 p.m. Reception by the Anjuman-e-Tarraqi-i-Urdu.

7 p.m. Lecture by Prof. F. J. M. Stratton on Storms in the Sun.

Tuesday, Jan. 19.

9-30 a.m. Presidential Address : Education Section,

10-30 a.m. Presidential Address : Agriculture Section.

11 a.m. Lecture by Mr H R. Mills on Scientific Methods in Technical Training.

11-30 a.m. Presidential Address : Engineering Section.

2-30 p.m. Presidential Address : Chemistry Section.

3-00 p.m. Presidential Address : Physics Section.

- 3-30 p.m. Opening of the Science Exhibition by Hon'ble Dr. Ishtiaq Husain Qureshi, Minister of Education, Government of Pakistan, Karachi.
- 4-15 p.m. Reception by Members of the Reception Committee.
- 5-45 p.m. Lecture by Prof. Julian Huxley on Evolution and Modern Thought.
- 8-30 p.m. Variety Entertainment.

Wednesday, Jan. 20,

- 9-30 a.m. Presidential Address: Biology Section.
- 10-30 a.m. Lecture by Prof. Julian Huxley, on Polymorphism and Evolution.
- Lecture by Prof. Nuzhdin on "Michurin teaching—the foundation of Soviet Biology."
- 10-45 a.m. Presidential Address: Geology, Geography Section.
- 11-30 a.m. Presidential Address: Medicine Section.
- 2-30 p.m. Symposium on Possibilities of the development of Chemical Industries in Pakistan.
- 4-15 p.m. Reception by Mr. A. M. Quraishi, President, Governing Body, Islamia College.
- 5-45 p.m. Lecture by Professor M. Afzal Husain on Democracy on the Dissection Table.
- 8 p.m. Dinner by Karachi Steel Rerolling Mills.

Thursday, Jan. 21,

- 9-30 a.m. Symposium: on "Allergy"
- 10-30 a.m. Lecture by Dr. Erwing Buenning on Plant Growth and Day Light and by Prof. George Antonoff on Nature of Gases.
- Huxley—Nuzhdin Discussion on the Science of Genetics.

12 noon. Annual General Meeting of Pakistan Scientific Workers Association.

1 p.m. Lunch by Pakistan Industrial Development Corporation

2-30 p.m. Symposium on Science in Pakistan.

4-15 p.m. Tea at Hyderabad Trust Industries, Steel Rerolling Mills, Landhi.

8-30 p.m. Variety Entertainment.

Friday, Jan. 22. Business Meetings of Sectional Committees.

10-30 a.m. Symposium on Scientific Service in Pakistan.

11-30 a.m. Meeting of the National Committee of Geodesy and Geophysics.

2-30 p.m. Annual General Meeting of the Pakistan Association for the Advancement of Science.

7 p.m. Film Show by Philip Electric Co., Ltd. on Atomic Physics.

Saturday, Jan. 23.

9 a.m. Annual Meeting of the Pakistan Academy of Sciences.

10 a.m. Symposium on A plan for Higher Education.

11-30 a.m. Excursions to Haleji Lake and C. J. W. B. Filter Plant.

11-30 a.m. Annual meeting of the Pakistan Geographical Association.

4 p.m. Reception by Hamdard Dawakhana Trust, Nazimabad.

Sunday, Jan. 24. Excursions and visits to Thatta, Kotri barrage, etc.

Note. All social functions and entertainment programmes arranged for Friday Jan. 22 and after were cancelled because of the tragic Jhimpir train crash.

LIST OF DELEGATES

Britain

Prof. F. J. M. Stratton, O.B.E., F.R.S., Caius College, Cambridge.

Prof. Julian Huxley, F.R.S.

Mr. L. H. Alliston, London.

Egypt

Dr. Ibrahim Helmi Abd-al-Rahman, F.R.A.S., National Research Council of Egypt.

France

Dr. M. Jacques Coulomb, Director, Institute de Physique du Globe, Paris.

Germany

Prof. Dr. Erwin Bünning, Director, Institute of Botany, University of Tübingen.

India

Dr. S. S. Bhatnagar, Secretary, Ministry of Natural Resources and Scientific Research.

Indonesia

Dr. Sudjito Danusaputro, National Academy, Djakarta.

Netherlands

Prof. J. T. Thijssse, University of Delft.

Burma

U. Hla Nyunt, University of Rangoon. U. Aung Khin, University of Rangoon.

U. Thein Mung, University of Rangoon.

Afghanistan

Dr. Mir Najamuddin Ansari, Ministry of Education, Kabul.

U.S.S.R.

Dr. N. Nuzhdin, Institute of Genetics, U.S.S.R.

Turkey

Prof. Abdulhâk Kemal Yörük, Professor of Philosophy of Law, Istanbul University.

Unesco

Prof. W.E. Purnell, Head, Unesco Science Co-operation Office for Middle East, Cairo.

East Bengal

Dacca University :

Dr. W. A. Jenkins.

Dr. S. M. Mirra.

Mr. W. S. Kadri

Dr. G. Jilani.

Dr. M. O. Ghani.

Dr. M. H. Khundkar.

Dr. Nafees Ahmad.

Dr. A. M. Chaudhury.

Rajshahi University :

Dr. A. Haque

Dr. Khan

Government of Pakistan

Ministry of Industries :

Dr. S. Siddiqui, Director, C.S.I.R.	Dr. Nzeer Ahmad, Technical Secretary
Dr. S.A. Saboor, Senior Research Officer	Dr. M. M. Qureshi, Research Officer
Dr. S. A. Wars, „ „ „	M. S. J. Quadir, Tech. Asstt., C.S.I.R.
M. Serajul Haq, Research Chemist, C.S.I.R.	
Mushtaq Ahmad Chaudhry, Central Laboratory, Karachi	
Manzurul Hasan	„ „ „
S. Sadiq Ali Ahmad	„ „ „
Dr. Naseem Ahmad	„ „ „
Raza Farid Khan	„ „ „
Dr. H. K. Gore, Deputy Secretary	Mr. S. M. Ayub, Under Secretary
Dr. Daud Ali, Director, Pakistan Standards Institute, Karachi.	

Ministry of Education :

Dr. S. M. Ali, Education Officer.

Pakistan Tariff Commission :

Dr. Nazir Ahmad, Chairman.
Mr. A. F. Mehesri, Technical Officer

Post & Telegraphs Department :

M. M. Khatib, Deputy Chief Engineer.

Survey of Pakistan :

Mr. C. A. K. Innes-Wilson, Surveyor General	
Mr. A. R. Qureshi, Assistant Surveyor General	Mr. G. H. Khan.

Geological Survey of Pakistan, Quetta :

Mr. M. I. Ahmad, Geologist	Mr. J. M. Master, Geologist
Mr. M. Ahmad, „	Dr. M. H. Khan, Palaeontologist
Mr. M. A. Wahid, Chemist	Mr. Abul Farah, Assistant Geologist
Mr. A. N. Fatmi, Assistant Geologist.	

Royal Pakistan Navy :

Mr. Mohammad Akhtar Yehya.

M. G. O. Branch, G. H. Q. Rawalpindi :

Dr. M. Afaf	Captain M. Iqbal	Dr. M. T. Choudhury
Mr. N. H. Khan	Mr. S. Mumtaz Hussain.	

Medical Directorate, G.H.Q. Rawalpindi :

Lt. Col. M. Said	Major S. M. H. Bokhari	Capt. M. A. Mirza
Mr. R. L. Heasman.		

Pakistan Forest College and Research Institute, Abbottabad :

Dr. S.A.A. Anvery, Director	Dr. A. H. Khan, Forest Botanist
Dr. M. B. Rahman, Forest Chemist	Dr. Abdul Hameed, Forest Botanist.

Sind

Mr. T.R. Sethna, Superintending Engineer	Mr. F.D. Abreo, Executive Engineer
Mr. Muhammad Akram, „ „	Mr. Ziauddin Sheikh „ „
Mr. S.M. Akhtar, Executive Engineer	Taj Muhammad Sheikh „ „
Mr. Muhammad Rafi Ahmad Sheikh, Secretary to Government of Sind.	
Md. Zakir Husain Qureshi, Govt. College, Hyderabad	
Dr. A. M. Sheikh, Director of Agriculture	
Dr. A. G. Pirzada, Joint Director of Agriculture.	
Sir Roger Thomas, Sind Land Development Corporation, Mirpurkhas.	

N.-W.F.P.

Agriculture Department :

Mr. Fazal-i-Rahim Khan, Director	Mr. A. E. Palmer, Director of Research
Mr. Mohammad Sulyman, Botanist	Mr. Mohammad Sarwar, Mycologist
Mir Aslam Khan, Statistician	Mr. Said Kamal Khan, O i/c Pastures
Mr. Fazal Dad Khan, Entomologist	Mr. Abdul Manan Khan, Entomologist.

Education Department :

Prof. Nawazish Ali, Govt. Islamia College
 Miss Asif Jalil, Frontier College for Women
 Miss Jamila Mehtab, „ „ „

Peshawar University :

Dr. M. R. Siddiqi, Vice-Chancellor	Dr. M.S.H. Siddiqi, Principal, Engg. College
Dr. Shamsul Islam Khan, Senior Lecture in Botany	
Dr. W. L. Orr, Prof. of Electrical Engineering	
Dr. Brielani, Professor of Political Science.	

Panjab

Panjab University, Department of Chemistry :

Dr. M. I. D. Chughtai	Dr S. A. Faseeh	Dr. Mohammad Amin
Mr. Riaz-ur-Rahmam	Mr. Ilyas Dubash	Mr. Zafarullah
Mr. Abdul Wahid Khan	Mr. M. S. F. A. Abidi.	

Department of Geography :

Dr. K. S. Ahmad	Mr. Aazarullah.
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Department of Statistics :

Dr. M. Zia-ud-Din

Department of Physics :

Mr. Athar Zia	Mr. Shameem-ud-Din	Mr. Muhammad Muazzam
Mr. M. Abdul Khaliq	Mr. A. H. Sulehri	Mr. M. Islam Khan Saeed.

Department of Zoology :

Dr. M. Sharif	Dr. Muzaffar Ahmad.
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Agriculture College and Research Institute, Lyallpur :

Prof. A. W. Chaudhry, Principal	Prof. G. D. Ahmad
Mr. Zafar Alam, Oil Seed Botanist	Dr. Abdus Sttar, Plant Pathologist
Mr. Sadiq Ali, Fruit Specialist	Khan Abdul Wahhab Khan, Agri. Chemist
Mr. Anwar Hussain, Agri. Chemist	Khan Sardar Khan Cereal Botanist
Lt. Comer A. Latif, Entomologist	Mr. N. D. Yusuf, Sugarcane Botanist
Mr. A. H. Khan, Cotton Botanist	Ch. Karam Rasul, Assoc. Prof. of Agri.
Khan Abdul Rashid, Veg. Botanist	Ch. Abdul Ghafoor Bhatti, Agri. Assitt.

Public Works Department :

Khan M. Azam Khan	Dr. A. G. Asghar	Mr. Nazir Ahmad Jiabaji.
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Government College, Lahore :

Dr. Sultan Ahmad	Prof. Q. M. Aslam	Dr. Ahmad Ali Qureshi
Dr. Mohammad Ajmal	Miss Chand Khurshid.	

F. J. Medical College, Lahore :

Dr. G. M. K. Baloch.

Punjab Engineering College, Lahore :

Mr. Hakim Ali, Vice Principal	Mr. A. R. Nasir, Asstt. Prof of Mathematics.
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F. C. College, Lahore :

Mr. Khairat Mohammed, Chemistry Deptt.	Dr. John Martin, Physics Deptt.
Mr. Ghulam Abbas, " "	Miss Nighat Masud, " "

Lahore College for Women :

Dr. Majida Mehtab, Department of Zoology.

Dyal Singh College, Lahore :

Mr. Mohammad Aslam Khan	Prof. F. D. Anjum Roomani.
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M. A. O. College, Lahore :

M. A. F. Faridi, Head, Department of Biology.

Government College, Chakwal :

Mian Mohammad Sharif, Department of Chemistry.

Fazal-i-Omer Research Institute, Rabwah :

Mr. A. R. Ghani	Mr. N. M. Sial.
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Sir Williams Robert, B. C. G. A., Khanewal

Dr. Noor Hussain, Chief Medical Officer, Sialkot.

S. M. Ahsan Ilahi, National Rubber Works, Sialkot City.

Mian Allah Bakhsh, Lyallpur.

Ch. Sardar Muhammad, Lyallpur.

Dr. Abdul Ahad, 3, Nisbet Road, Lahore.

Baluchistan

Mr. Abdul Haye Khan, Pakistan Industries Ltd., Hindubagh.

Bahawalpur

Hafiz Mohammad Abdul Haque, Principal, S. E. College.

STUDENT DELEGATES

A. R. Gilani	Miss Akhtar Sultana	Miss Sophia
Miss Feroza Ahmad	Miss Akhtar Hameed	Miss Khawar Khan
Aslam Iqbal	Miss Shireen Vania	Miss Taj Khan
Mansur Ahmad	Miss Iftakhar-un-Nisa	
Abdur Rashid	Anwar Minhas	A. Hameed Tahir
Abdul Hafiz	Afzal Mirza	Zulfiqar Ali
Muhammad Ahmed	M. S. Pervaiz	Rafat Hussain
Muhammad Ali	Abdul Rashid	Yusuf Munir
Ghulam Raza	M. Daood.	
Shaukat Khurshid	Muhammad Afzal	Khadim Ali Hashmi
Shamshad Ahmad	Sher Muhammad Zafar	Zia Ullah
M. A. Khokar	Aziz-ur Rahman	Malik Youssouf
Nur-ul Haq	Anwar-ud-Din Ahmad	Muhammad Sharif
Muhammad Arshad	Muhammad Abbas Khan	Munawwar Shafqat Ullah
Abdur Rahman Tariq	Muhammad Saeed Ashraf	Abdul Qayyum
Syed Safdar Nawab	M. Razi Abedi	Syed Badarul Islam
Murtaza Ali Abedi	Liaqat Ali Khan	Zahur-ud-Din
Muzaffar Ali Shah	Muhammad Abdul Haleem	Zafar Mansur
Irshad-ur Rahman	Muhammad Zafar	Mazher Aleem
Itrat Hussain Qureshi	Muhammad Shamim	Muhammad Saeed
Mohammad Hussain	Riaz-ud-Din	Abdul Hayee
Abdul Qayyum	Abdul Rashid	Fazal Mahmood
Amir Qazi	A. U. Akmal	M. Ajmal Mirza
M. Zafar	Ahmad Rashid	Nur Ahmad
Ijaz Ahmad	Iqbal Ahmad	Saeed Chaudhury
M. Lodhi	Bashir Ahmad	John H. E. Malik
Hakim Ali	Muhammad Ahmad	Asghar Hamid
M. A. Siraj	Mohammad Akbar	Sher Mohammad
Ziaul-Haq Qureshi	Mohammad Isbaq	Nasar Ullah Atish
Mohammad Munir	S. M. Hassan	M. Saeed Khan
Razi-ud-Din	Mumtaz Ali	Mohammad Rafique
Khurshid-ul-Islam	Mohammad Arif	Mohammad Saeed
Arshad Munir	Fazal Ilahi	Mohammad Jan Nisar
M. Ismaeel	Miss Mamtaz Jamil	Miss Saadat Bano
Mazhar Hussain	Miss Farhat	Miss Naseem
Miss Mabel	Miss Mumtaz Yasmin	Miss Amina Rahman

OPENING PROCEEDINGS

INTRODUCTORY SPEECH

BY

DR. BASHIR AHMAD,

Retiring President, Pakistan Association for the Advancement of Science.

Scientific societies today form an integral part of the organisation of science and play an essential and indispensable role in its development. The publication of scientific papers comprising of new advances in different fields of science, the organisation of meetings of scientific workers for mutual discussion of their problems, and the provision of an essential link between science as a whole and the general public, are their main and important functions. These functions are essential for the development of science and are fulfilled only by voluntary scientific Associations organised, maintained and administered by scientists themselves.

When independence was achieved in 1947, Pakistan had not only no valuable scientific assets, it had no scientific Associations, which are the main instruments for scientific development. If science was to be developed in the new country, no time was to be lost in organising a scientific society to fulfil some of the essential functions I have mentioned before. The Pakistan Association for the Advancement of Science was established in December, 1947, and in the first few years was the only scientific society in Pakistan. It was called upon, therefore, to undertake a variety of specific functions undertaken in other countries by different societies. In the course of the last few years, other societies are slowly growing up and taking up work in their own specific fields. I may mention a few of them. The Pakistan Geographical Association was established in 1948, the Pakistan Chemical Society in 1949, the Pakistan Association of Scientific Workers in 1950, the Physical and Mathematical Society in 1952; and last year the Pakistan Academy of Sciences was inaugurated by the Prime Minister of Pakistan on 19th February 1953, in Lahore. The Pakistan Association for the Advancement of Science, as the parent Association, has sponsored these Societies, helped in their formation and provided them with funds and the wherewithal to put them on their way to development and progress. The Pakistan Association for the Advancement of Science has also most willingly

divested itself of such functions as legitimately belong to these younger bodies. This process will evidently go on for some years, when eventually this parent Association will retain only limited functions fulfilled generally by national Associations for the Advancement of Science in other countries of the world.

One of the main programmes of work of the Pakistan Association for the Advancement of Science during the six years of its existence has been the promotion of scientific research by the award of Fellowships. Funds for these have been made available by Government, the Imperial Chemical Industries and His Royal Highness the Agha Khan. The Imperial Chemical Industries donated a sum of Rs. one lac and sixty thousands spread over a period of five years, and His Royal Highness donated £ 12,000 for Fellowships spread over a period of three years. The Pakistan Association is particularly grateful to them. Now that the Pakistan Academy of Sciences has been established, it can appropriately take up the responsibility for this work as soon as it is able to do so.

The second important activity of the Association has been the publication of the first two scientific journals in Pakistan. These are the Pakistan Journal of Science and the Pakistan Journal of Scientific Research. Both these are quarterly Journals and have been published with a fair degree of regularity. Now these are in their sixth year of publication. Four volumes have already been completed. The Publication of these have been possible by a regular recurring grant from the Punjab Government. These Journals have not only fulfilled an important need of providing a means for the publication of the research work of scientific workers in Pakistan but have also made available much valuable scientific literature. The Journals have an exchange list of 140 and cover important scientific publications of most of the countries in Asia, Europe, Africa, Australia and North and South America.

The third and perhaps, the most important activity of the Association has been the organisation of an Annual Science Conference. The Conference which H. E. the Governor-General of Pakistan is inaugurating today is the Sixth Annual Conference in the sixth year of the life of the Association. The success which has attended the Conferences has made these the most outstanding achievement of the Association. This success has been due to the co-operation of all scientists in Pakistan, from almost all spheres of work, from the Government scientific Services, from research institutions, from industry and from the universities. The universities have also co-operated most generously by extending invitation to the Association to hold the Conferences under their auspices in their premises and by placing all possible facilities at their disposal. More than that, Scientific Associations

in other countries have generally cooperated to help the young Association and have sent scientists of eminence and repute to participate in their proceedings. This has raised the level of discussions, and made these Conferences truly international and of real value for the development of science in Pakistan. Amongst the countries which have generously cooperated, I would particularly mention Britain, U.S.A., India, Turkey, Egypt, Iran, Australia, New Zealand, Ceylon and Burma.

No account of the achievements of the Pakistan Association can be complete without mentioning the generous help and support which science has received and continues to receive from the Government in this country. As soon as the Association was formed in Lahore, the Punjab Government made a generous grant of Rs. 25,000 which gave it a good start. Then the Central Government gave it official recognition and patronage and a grant of Rs. 50,000. Other Provincial Governments also made substantial grants. The grants from the Central Government and the Punjab Government have continued every year. Without these grants and without the interest which H. E. the Governor-General, Hon'ble the Prime Minister, the Governors of Provinces and other Ministers of the Central and Provincial Governments have shown, this work would not have been possible.

One of the important items of further programme of work of the Association is the building of a Science House at each of the three centres—Karachi, Dacca and Lahore. The Science House will accommodate the offices of the Association, the Academy, and other scientific Societies in Pakistan. It will have a first class reference library of scientific literature and will also have a modern auditorium for lectures and conferences. The cost of each Science House is estimated at Rs. 10 lacs. Arrangements for the building in Lahore have already progressed to a considerable extent and at the other two places are to be taken up shortly.

With these few words on the past and future work of the Association, Mr. President, I have pleasure in handing over the charge of the General Presidentship to you this morning. I have no doubt that the Association will flourish more than ever under your Leadership.

ADDRESS OF WELCOME

BY

PROF. A. B. A. HALEEM,

Vice-Chancellor, Karachi University and Chairman, Reception Committee.

YOUR EXCELLENCY, MR. PRESIDENT, LADIES AND GENTLEMEN,

I deem it a great privilege to be in a position to convey my grateful thanks as well as the grateful thanks of all the members of the Reception Committee of the Sixth Pakistan Science Conference to His Excellency Mr. Ghulam Mohammad, Governor-General of Pakistan, for having very kindly acceded to our request to inaugurate this conference. By accepting our invitation and by finding time to be in our midst today, in spite of his numerous engagements and the heavy cares of office which beset him, His Excellency has evinced his deep interest in the pursuit of scientific inquiry and research. I am sure that his solicitude for the welfare of the Pakistan Association for the Advancement of Science and his interest in the deliberations of this conference will be a source of encouragement to all those who are engaged in scientific investigation in this country.

It is also my privilege to extend a warm and sincere welcome on behalf of the University of Karachi and the members of the Reception Committee to all the delegates and visitors to this conference. It is nearly four years since the second Pakistan Science Conference met at Karachi under the auspices of the University of Sind. During this period important developments have taken place in the city in general and its educational structure in particular. Karachi has developed rapidly as a centre of trade, commerce and industry; its growth as a seat of business, its expansion in size and the enormous increase in its population have created serious social, economic and educational problems for the Government.

In June, 1951, the University of Sind moved across to Hyderabad and the vacuum created by its departure was filled in by the Karachi Board of Secondary Education and the University of Karachi. The former took over the work of reorganising and supervising Secondary Education and conducting the High School Final Examination, while the latter took over the task of reorganising higher education in the city. While the University of Sind with its very meagre grant from the Provincial Government was compelled to function merely as an affiliating and

examining body, the University of Karachi, which has taken its place within the limits of the Federal Capital, has launched an ambitious scheme of centralising all Honours and Post-graduate teaching and research directly under the University. Realising the need for a close collaboration between fundamental and applied studies and research in all sciences the University has not only organised departments of pure science such as Mathematics, Physics, Chemistry, Zoology, Botany and Geography, but is also planning to set up in the near future departments of Applied Mathematics, Applied Physics, Applied Chemistry and an Institute of Applied Biology. At present the University is functioning in a number of old School buildings which have been made over to it by the Government of Pakistan and which have been hastily reconditioned to suit its requirements. This is merely a make-shift arrangement and the Syndicate has moved the Government for the grant of a suitable site for a University campus in the vicinity of Karachi. It has also submitted a scheme for a modest University town at an estimated cost of approximately seven crores of rupees, which has been adopted by the Government and incorporated in its Six Year Development Plan of Education. The fulfilment of the schemes worked out by the University for the furtherance of scientific study and research will have an important bearing on the future of Pakistan and its economic and industrial development. On the other hand, the growth of Karachi as the largest industrial centre in the country is likely to help in the quicker development of the departments of applied science in the University, which on its part will always be ready to play its role in the growth of industries and technical enterprises.

Ladies and Gentlemen,

The Universities of Pakistan have a great part to play in the future development of this country. Four years ago, speaking from this very platform, I had an opportunity of pointing out that 'thanks to the foresight and acumen of our next-door neighbours and our erstwhile compatriots, all the All-India institutions of higher research were located in Hindu-majority areas, and, consequently, when this sub-continent was partitioned, they all remained on the wrong side of the border.' This loss makes it necessary for us to create national institutes for the furtherance of research in different branches of science, and it is gratifying to note that a beginning has already been made by the establishment of the Council of Scientific and Industrial Research at Karachi. The creation of such institutes will not, however, in any way detract from the importance of the Universities. They will remain the main seats not merely for the teaching of sciences but also for the furtherance of scientific investigation.

The history of science has shown that most of the leading discoveries of facts of scientific importance were made in the Universities. Moreover, the scienti-

fic method and the scientific discipline are in a sense the creation of a larger method and a larger discipline which are the outcome of University education. It is, therefore, incumbent on the Governments, Central and Provincial, as well as the public, to provide the Universities with ample funds and to subsidize their schemes for the development of research in different branches of science. The industrialists of Pakistan have a special duty in this connection. In the advanced countries of the West the leading industrial concerns not merely endow research fellowships and scholarships and subsidize scientific and technical investigations in the Universities, but they also maintain elaborate laboratories and research organisations of their own at enormous expenditure.

Ladies and Gentlemen,

It is extremely gratifying to find that a large number of distinguished delegates have assembled here today and that many eminent scientists from different parts of Pakistan as well as from foreign countries have responded to our invitation. It is a happy augury not merely for the furtherance of scientific studies and research but also for the future development of this country. I hope that by bringing together persons working in different branches of science this conference will be able to focus attention on many important problems vitally affecting the future of this country, and will help to awaken the public of Karachi—especially the industrial community—to the importance of scientific and technological investigation.

In conclusion, I thank Your Excellency once more for honouring us by your presence and request you to inaugurate the conference.

INAUGURAL ADDRESS

BY

HIS EXCELLENCY MR. GHULAM MOHAMMAD

Governor-General of Pakistan

It is a great pleasure for me to inaugurate the sixth annual session of the Pakistan Science Conference and to welcome the delegates. The presence of distinguished delegates from countries abroad is a matter of special gratification for us as the chief aim of a Science Conference should be to share the experiences of fellow scientists in other parts of the world. Personal contacts and discussions, more than anything else, are the most effective means of consolidating the unity of scientific endeavour among scientists for the betterment of human destiny.

Science by its very nature has become the most dynamic factor in the international field of knowledge. It has grown through the contributions of individuals in many lands having a common background of experience and employing research tools of similar pattern. None of its branches has developed in isolation in any particular part of the world. Discoveries of fundamental nature do not remain secrets within the boundaries of a country.

Scientific knowledge and research have in our times made available for the service of human life vast discoveries which have affected life over most parts of the world in a much greater degree than in any other period; but thinking minds are not unconscious of the powers of destruction of life which have become available to man as a result of some of the discoveries, so much so that the means of destruction now known frighten human beings and one cannot contemplate with much hope what future course events may take.

It seems all the more necessary that humanity should pursue with vigour scientific knowledge and research so that we would conquer nature and make available to man what is not known to him now. But one has to depend only on the growth of a greater and deeper consciousness in man for peace and avoidance of conflict, if humanity is to enjoy the fruits of discoveries. The conflict involved is thus perennial, inherent in every growth of knowledge. The instinct of preservation and the desire for gain, by the use of means not always and equally available to every section of humnity are there and have been there and yet humanity has been able to go on.

It is true that the choice of the use of scientific knowledge is the responsibility of layman and the scientist alike, but the latter has a special part to play in

ensuring that his research is used for the happiness and welfare and not for the destruction of mankind. This is a matter of great importance which requires serious consideration by the scientists of our Age. We have before us the example of Alfred Nobel, the father of modern explosives "turning his face away from the contemplation of his own triumphs and seeking after his death to set men searching.....for the establishment of peace among men."

The wording of the deed establishing the most coveted Nobel Peace Prize is worth attention. It is to be awarded to the person "who shall have most or best promoted the fraternity of nations and the abolition or diminution of standing armies and formation or increase of peace congresses."

Pakistan with its limited resources has during the past six years been heroically repairing the colossal damage to its intellectual and economic structure wrought by the upheavals which came in the wake of its independence. It was the courage of our people which overcame the initial chaos. The educational and scientific institutions in Pakistan were no exception to the general conditions. Even if conditions had remained normal, Pakistan would have had considerable leeway to make up. Only three universities out of over twenty-one universities of prepartition India came within the boundaries of Pakistan. The position in respect of institutions of higher research in science was equally bad and all the major and important research institutions remained outside Pakistan.

The three new universities of Karachi, Peshawar and Rajshahi established after partition are engaged in organising teaching and research departments of science subjects.

The Council of Scientific and Industrial Research, the Government Test Laboratories at Karachi and other such research institutions have also been established by the Government. However, a great deal is yet to be done to introduce scientific methods in agriculture and the exploitation of the natural resources of our country on a large scale. Similarly, the development of industry is also in its infancy.

It was in consideration of these facts and in order to make available as quickly as possible the necessary teaching and research staff, technicians and engineers of high calibre, that the Central Government and some of the Provincial Governments launched overseas training schemes which have been in operation since the establishment of Pakistan. Under these schemes and the Technical Co-operation Programme, increasingly large numbers of young graduates as well as service personnel have been proceeding overseas for further study.

The position regarding trained personnel is, therefore, steadily improving.

Our men after their training and research abroad, have come back with broader outlook and a better grasp of new techniques and methods of approach.

Another useful step taken by the Central Government is the appointment of a Scientific Liaison Officer in the UK whose functions include keeping in touch with the scientific developments in that country, and to help in the exchange of scientific information and personnel between the two countries.

In an underdeveloped country like ours, the limited resources at our disposal have to be utilised wisely in order to avoid any duplication or wastage of effort and energy. Our own resources coupled with foreign assistance in the form of expert advisory services, training facilities and equipment available under the various Technical Assistance Programmes, if utilised according to a well-planned programme, should enable us to a large extent to overcome the initial handicaps in the consolidation of our science teaching and research on the national basis.

The real solution will, however, be found in our own efforts. A co-ordinated plan providing for the re-orientation of science teaching at the secondary and university levels, organisation of first-rate departments of fundamental research at the universities and a close liaison between the research departments of the universities and the institutions of applied research is, therefore, absolutely essential.

We need many more institutions for training personnel for our growing industries as well as for improving our agriculture which will long remain our basic industry. This national task requires a coordinated and concerted effort on the part of all concerned in order to produce the best result with the minimum of wastage of our meagre material resources.

I have full confidence in the genius of our people and it is my hope that our educators, men of science and research leaders will prove equal to the gigantic task which lies ahead of them.

I wish all success to the deliberations of this Conference and sincerely hope that it will bring about increasing co-operation and understanding between the scientists of our country and those of other countries.

GOODWILL MESSAGES

Dr. E. D. Adrian, President, British Association for the Advancement of Science

I have just assumed office as President of the British Association for 1954, and one of my first duties is the very pleasant one of sending to the President and to all the members of the Pakistan Association, our cordial greetings and best wishes for the success of the Sixth Pakistan Science Conference.

The General Secretaries join me in hoping that the Conference in Karachi will add new lustre to the reputation which your Association has already won by promoting the advancement of Science, and by providing a forum for discussion between scientists from many countries.

We greatly appreciate the opportunity of being represented, and we shall look forward to receiving from Professor Stratton up to date news of Pakistan's achievements in science and its applications.

Dr. S. S. Bhatnagar, F.R.S., India

I have great pleasure to be in Karachi on the occasion of the Sixth Session of Pakistan Science Conference. If I were asked to allocate a satisfactory term to define the relationships between India and Pakistan, I shall describe them as Isotopes. I am particularly happy to find that His Excellency the Governor-General is taking personal interest in the development of Science in Pakistan. This is auspicious as I recollect with personal pride and affection his association with India's early programme of Scientific and Industrial development. His Excellency was the first Vice-President on India's Council of Scientific and Industrial Research and if we have made a success of it, it is largely due to our Prime Minister's active interest in science and because of the early inspiration for work, I derived from H.E.'s personal enthusiasm, when he was my Vice-President. India looks upon this Conference as a sister organization and we wish your scientists all the success which they deserve. This country needs Science and more Science and I am sure with the aid of Science and Technology, Pakistan will reach great heights of glory and prosperity.

Dr. M. J. Coulomb, France

Through accidental delays, it was only a week ago, that I learnt that I was to represent France at this Sixth Science Conference. I was immediately enthusiastic about the possibility of seeing with my own eyes the enormous progress which has been made recently in your country, particularly, in the domain of geophysics in which I teach. France, has always been in favour of international collaboration; for instance, as member of the United Nations, she has strongly supported projects

for international Institutes and Laboratories. I would be glad to encourage all possibilities of scientific good relations between our two countries.

As professor at the University of Paris, the oldest University in France, I have pleasure in bringing its warmest greetings to its young sister University of Karachi. Lastly, as a member of the Council of the French Association for the Advancement of Science, I would like to express my admiration for the vitality of your great Pakistan Association and to assure you that I will do my best to contribute to the success of your Sixth Conference.

Dr. Sudjito Damusaputro, Indonesia

It is a great honour for me to represent Indonesia at the sixth Pakistan Science Conference and I am thankful to the Government of the Republic of Indonesia for conferring this honour upon me.

From a perusal of the programme and souvenirs I find that there is great progress in Scientific education in Pakistan, and I am sure that this progress will not be of benefit for the people of Pakistan only but also for all mankind.

Prof. J. Th. Thijssse, Netherlands.

I want to express my thanks for the invitation to this Conference. In his Address the President has stated the tremendous progress and differentiation of science. It is clear that no delegate can be found who is an expert on every subject. So a choice had to be made and it will not surprise anyone that this delegate is a student of the behaviour of water.

The very existence of both Pakistan and the Netherlands depends upon water. At first sight the situation is quite different in our countries, but scientifically speaking there is much in common between bringing water to the places where it is needed most of all and evacuation of water from places where there is too much of it. Moreover parts of Holland are as badly in want of fresh water as parts of Pakistan are.

It is evident that I will only follow the proceedings in the Engineering Sections with much interest but I must express the hope that the conference will be very successful in all its Sections.

U. Hla Nyunt, Burma

On behalf of the University of Rangoon and the Burma Science Association I wish to tender our heartfelt congratulations to the Pakistan Science Association for organising these Conferences. We shall follow the proceedings of these Conferences with great interest, because the problems facing Burma are very similar to the problems facing Pakistan, as mentioned in the Presidential Address.

I wish the Conference every success

Prof. W. E. Purnell, United Nations Economic,
Scientific and Cultural Organization.

This is the fifth occasion that I have had the honour of offering on behalf of the Director General of Unesco our very best wishes for the success of this Pakistan Science Conference, for the continued increasing success of the Pakistan Association for the Advancement of Science, and I am pleased and proud to be with you once again.

The progress that has been made in these four years is good but it is our confident hope that you will not be content to rest on your past achievements and successes but that you will go forward effectively in all the various disciplines of science, increasingly influencing your Governments not only in the best use of the applications of your scientific work and in the right use of Scientists but also in the application of the scientific method to government administration.

This latter subject is one that becomes increasingly important as your development projects take shape and go into operation. It is essential that you do not burden yourselves down with an archaic bureaucratic clerical system designed to operate before the advent of modern means of communications.

You cannot afford the luxury of the old fashioned office methods of "Passed to you please;" and much as we as chemists, biologists, physicists tend to disregard the clerical aspects, yet as working scientists some of our worst problems result from bad, lax administrative procedures and incompetencies.

I am quite sure that if the application of operational research to government administration were tried out in a new country like yours; the savings, not only in time and money, but also in the avoidance or minimising of the feeling of frustration when the wrong apparatus turns up six months late, will more than justify the research effort.

But don't think that the implementation of any such application of Science to Government can be accomplished overnight—it is something that can be achieved if you will give enough attention and effort to it but only over a period of years.

As you know my new Director General, Dr Luther Evans, himself a scientific administrator is keenly interested in the activities of the various Associations for the Advancement of Science. As yours is the only Association for the Advancement of Science in the Middle East region, he has asked me to assure you of his personal interest in this sixth Pakistan Science Conference, and to wish you every success in it.

H. E. Mr. Khaliqzaman Governor of East Bengal

I am glad that eminent scientists from ours and many other countries of the world are attending the 6th Annual Session of the Pakistan Science Conference which is being held at Karachi under the auspices of the Pakistan Association for the Advancement of Science. I am sure, it will be very interesting for our own scientists to hear from our visitors at first hand about all that is being done by them in their own countries to harness the forces of nature and to bring them into the service of man. The exchange of ideas and the discussions that are likely to take

place in this assembly of learned men of science will, I feel, be of great benefit to our country which is so much in need of advanced scientific knowledge and research for its rapid development. If this Conference results in stimulating interest in scientific research in our country, a most important object of holding it would, in my opinion, be amply fulfilled.

I wish the Conference every success in its deliberations.

H. E. Mr. Amin-ud-Din, Governor of the Punjab

It gives me great pleasure to send this message of greetings and goodwill to the Sixth Annual Session of the Pakistan Science Conference.

This Conference provides, in my view, a great opportunity for our scientists to meet and discuss the country's problems and at the same time to exchange ideas with the many distinguished delegates from foreign countries and to benefit from their knowledge and experience.

In this Atomic Age science has placed in the hands of man great possibilities both for good and evil and the responsibilities of the scientists are more grave today than at any time in history. I hope that the deliberations of this Conference of eminent scientists will conclude on a note of greater optimism, greater international goodwill and greater determination to work for human happiness and progress.

The scientists of Pakistan have to shoulder specially heavy responsibilities. They have not only to carry on scientific research but also to make a positive contribution to the material uplift of their countrymen. The dissemination of scientific knowledge and its practical application to our problems has to be accelerated and the traditional emphasis on the so-called cultural education has to be diverted to scientific education. The Association for the Advancement of Science deserves praise for the good work already done by it for the development of science in Pakistan, and I am confident that the future activities of the Association will greatly help our scientists in the performance of their difficult but noble task.

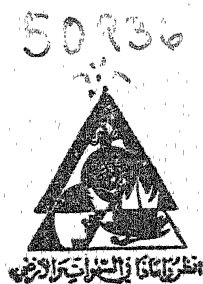
H. E. Mr. Habib I. Rahimtoola, Governor of Sind

Behind the technical marvels of modern civilization lies the unobtrusive and unremitting labour in laboratories of the men of science who are responsible for salvaging man from savagery to sense and placing him on a pedestal of command over the forces of nature and ravages of disease. Promotion of science, therefore, becomes the common adventure of mankind transcending all frontiers of nationality and race. Science congresses, which are convened to afford opportunity to scientists belonging to different countries to collect and confer on matters relating to their researches, serve an important function and play a great part in the propagation and promotion of scientific activities.

I am, therefore, glad to hear that the Pakistan Association for the Advancement of Science, has convened a conference to discuss the common and current scientific problems confronting our country, and I am sure that this would infuse in them a greater zest and zeal in their noble undertaking.

PROCEEDINGS
OF THE
SEVENTH
PAKISTAN SCIENCE CONFERENCE
BAHAWALPUR, 1955

PART I
OFFICIAL MATTERS
AND
OPENING PROCEEDINGS



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P R O C E E D I N G S

O F T H E

S E V E N T H

P A K I S T A N S C I E N C E C O N F E R E N C E

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PART I:—Official Matters and Opening Proceedings

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C O U N C I L
OF THE
PAKISTAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1955

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Dr. Kamaluddin Ahmad, Reader in Biochemistry, Dacca University.

Dr. S. D. Chaudhury, Director, Jute Research Institute, Dacca.

Dr. Badar-ud-Din, Director, University Institute of Chemistry, Lahore.

Dr. Karimullah, Deputy Director of Industries, Punjab, Lahore.

Dr. Taskhir Ahmad, Director, Department of Plant Protection, Karachi.

Dr. A. Kamal, Senior Research Officer, C.S.I.R., Karachi.

OFFICERS OF THE SEVENTH CONFERENCE

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Ameer of Bahawalpur.

PATRON

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General Secretary :

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Dr. A. M. Chaudhury, M.Sc., Ph.D., Dacca.

Sectional Officers

AGRICULTURE : ANIMAL HUSBANDRY AND FORESTRY

President : Dr. Taskhir Ahmad, Director, Department of Plant Protection, Karachi.

Secretary : Mr. Shafi Niaz, Deputy Director, Agricultural Economics, Karachi.

BIOLOGY : ZOOLOGY : BOTANY : ENTOMOLOGY

President : Dr. G. P. Mozumdar, Head, Department of Biology, Dacca University.

Secretary : Lt. Comdr. A. Latif, Entomologist to Punjab Government, Lyallpur.

CHEMISTRY : APPLIED CHEMISTRY

President : Dr. Badar-ud-Din, Head, Deptt. of Chemistry, Panjab University, Lahore.

Secretary : Dr. A. Kamal, Senior Research Officer, C.S.I.R., Karachi.

EDUCATION : SOCIOLOGY : PSYCHOLOGY

President : Dr. M. M. Sharif, Principal, Islamia College, Lahore.

Secretary : Dr. I. Latif, Professor of Psychology, Islamia College, Lahore.

ENGINEERING : IRRIGATION : HYDEL POWER : HYDRAULICS ETC.

President : Mr. A. D. Ashraf, Chief Engineer, (Irrigation), P.W.D., Punjab, Lahore.

Secretary : Mr. Sadiq Mohammad Niaz, Director General, Designs, P.W.D., Lahore.

GEOLOGY : GEOGRAPHY : ANTHROPOLOGY

President : Dr. O. Schmieder, Professor of Geography, Karachi University.

Secretary : Dr. S. M. Shuaib, Geology Department, Panjab University, Lahore.

MEDICINE : VETERINARY SCIENCES

President : Dr. S.M. Sarwar, Principal, Punjab College of Animal Husbandry, Lahore.

Secretary : Dr. S.M.K. Wasti, Professor of Medicine, K. E. Medical College, Lahore.

PHYSICS : MATHEMATICS : STATISTICS : ASTRONOMY : METEOROLOGY

President : Dr. S. M. Mitra, Head, Department of Physics, Dacca University.

Secretary : Dr. S. Karim, Head, Department of Physics, Karachi University.

SECTIONAL COMMITTEES

A.—AGRICULTURE : ANIMAL HUSBANDRY AND FORESTRY

- Dr. Taskhir Ahmad, Director, Department of Plant Protection, Karachi, (*President*)
Dr. Khan A. Rahman, Director of Agriculture, Punjab, Lahore.
Mr. Y. S. Ahmad, Inspector General of Forests, Government of Pakistan, Karachi.
Ch. Muhammad Afzal, Agricultural Development Commissioner, Karachi.
Dr. S. Hidayetullah, Director of Agriculture, East Bengal, Dacca.
Sir William Roberts, C.I.E., B.C.G.A., Civil Lines, Khanewal.
Dr. Abdus Sattar, Assistant Director of Agriculture, Punjab, Lahore.
Mr. Nisar Ahmad Khan, Deputy Director of Animal Husbandry, East Bengal, Dacca.
Mr. F. U. Ahmad, Principal Agricultural Institute, East Bengal, Dacca.
Dr. Nazir Ahmad, Director of Fisheries, East Pakistan, Comilla.
Dr. S. D. Chaudhry, Director, Jute Research Institute, Dacca.
Dr. A. M. Sheikh, Director of Agriculture, Sind, Karachi.
Malik Amanat Khan, Additional Director of Agriculture, Punjab, Lahore.
Mr. Fazal-i-Rahim Khan, Director of Agriculture, N.W.F.P., Peshawar.
Mian Mushtaq Ahmad, Chief Conservator of Forests, Punjab, Lahore.
Mr. Shafi Niaz, Deputy Director, Agricultural Economics, Karachi, (*Secretary*).

B.—BIOLOGY : ZOOLOGY : BOTANY AND ENTOMOLOGY

- Dr. G. P. Mezmudar, Head, Department of Biology, Dacca University, (*President*).
Dr. Abdus Sattar, Assistant Director of Agriculture Punjab, Lahore.
Dr. S. Hidayetullah, Director of Agriculture, East Bengal, Dacca.
Dr. M. Sharif, Head, Department of Biology, Government College, Lahore.
Dr. Hamid Khan Bhatti, Head, Department of Zoology, Panjab University.
Dr. Sultan Ahmad, Professor of Botany, Government College, Lahore.
Dr. Muzaffar Ahmad, Department of Zoology, Panjab University, Lahore.
Dr. Nazir Ahmad, Director of Fisheries, East Pakistan, Dacca.
Mr. Sher Ahmad Lodhi, Professor of Botany, Government College, Lahore.
Prof. M. A'zal Husain, Vice-Chancellor, Panjab University, Lahore.
Dr. Abdul Hamid, Forest Botanist, Pakistan Forest Research Institute, Abbottabad.
Dr. Shamusul Islam, Department of Botany, Dacca University, Dacca.
Dr. (Mrs.) B. B. Qureshi, Central Government College for Women, Karachi.
Dr. Rahimullah Qureshi, Director, Department of Fisheries, Karachi.
Lt. Commander Agha A. Latif, Entomologist, Agricultural College, Lyallpur,
(*Secretary*).

C.—CHEMISTRY : APPLIED CHEMISTRY

- Dr. Badar-ud-Din, Department of Chemistry, Panjab University, Lahore, (*President*).
 Dr. A. G. Asghar, Director of Land Reclamation, Punjab, Lahore.
 Dr. Ali Ahmad, Director, P. I. D. C., Karachi.
 Dr. M. O. Ghani, Head, Department of Soil Sciences, Dacca University.
 Dr. Karimullah, Deputy Director of Industries, Punjab, Lahore.
 Dr. M. I. D. Chughtai, Department of Chemistry, Panjab University, Lahore.
 Prof. Mirza Anwer Beg, Government Islamia College, Peshawar.
 Dr. Niaz Ahmad, Director, Institute of Chemical Technology, Panjab University.
 Khwaja Salahuddin, Institute of Chemical Technology, Panjab University, Lahore.
 Dr. Bashir Ahmad, Director, West Regional Laboratories, C.S.I.R., Lahore.
 Dr. Salimuzzaman Siddiqui, Director, Pakistan C. S. I. R., Karachi.
 Dr. S. A. Warsi, Senior Research Officer, C.S.I.R., Karachi
 Dr. Mofizuddin Ahmad, Reader in Chemistry, Dacca University, Dacca.
 Ch. Sardar Mohammad, Mohammadpur, Lyallpur.
 Dr. Ahmad Kamal, Senior Research Officer, C.S.I.R., Karachi, (*Secretary*).
-

D.—EDUCATION : SOCIOLOGY : PSYCHOLOGY

- Professor M. M. Sharif, Principal, Islamia College, Lahore, (*President*).
 Dr. Mahmood Husain, Professor of History, Karachi University.
 Professor B. A. Hashmi, Principal, Central Training College, Lahore.
 Dr. S. M. Hosain, Vice Chancellor, University of Dacca.
 Professor Q. M. Aslam, Head, Department of Psychology, Govt. College, Lahore.
 Mr. A. H. Alawi, Chairman, Department of Education, Peshawar University.
 Mrs. Saeeda Malik, Principal, Lady MacLagan College, Lahore.
 Prof. Siraj-ud-din, Principal, Government College, Lahore.
 Mr. S. M. Sharif, Director of Public Instruction, Punjab, Lahore.
 Dr. G. Jilani, Head, Department of Philosophy and Psychology, Dacca University.
 Prof. Taj Mohammad Khayal, Principal, Government College, Lyallpur.
 Mr. I. Y. Suleman, Principal, Training College, Karachi.
 Mr. M. Hasan, Principal, Hailey College of Commerce, Lahore.
 Miss Chand Khurshid, Government College, Lahore.
 Dr. I. Latif, Professor of Psychology, Islamia College, Lahore, (*Secretary*).
-

E.—ENGINEERING : IRRIGATION : HYDEL POWER : HYDRAULICS, Etc.

Mr. A. D. Ashraf, Chief Engineer, Irrigation, P.W.D., Punjab, Lahore, (*President*).

Mr. M. Azam Khan, Chief Engineer, P.W.D., Irrigation, Punjab.

Mr. Mohsin Ali, Chairman, Central Engineering Authority, Karachi.

Khwaja M. Azeemuddin, Chief Engineer, P.W.D., Irrigation, East Bengal, Dacca.

Pir Muhammad Ibrahim, Chief Engineer, P.W.D., Punjab, Lahore.

K. B. Sheikh M. A. Hamid, Chief Engineer, P.W.D., Punjab, Lahore.

Mr. A. F. Qureshi, Deputy Director, C. E. Authority, Karachi.

Dr. Nazir Ahmad, Physicist, Irrigation Research Institute, Punjab, Lahore.

Dr. Mir Mushtaq Ahmad, Hydraulic Officer, Irrigation Research Institute, Lahore.

Mian Nazir Ahmad Jiabaji, Executive Engineer, Mandi Burewala.

Mr. G. Quamber, 15-F, Club Road, Rawalpindi.

Syed Irshad Husain, Research Officer, B. and R. Research Labs., Lahore.

Mr. S. M. Hasan, Chief Engineer, P.W.D., Punjab, Lahore.

Mr. Abu Nasir, Engineering College, Dacca.

Mr. Majid Hasan, Agricultural Engineer, Agricultural College, Lyallpur.

Mr. Sadiq Mohammad Niaz, Director-General, Designs, Irrigation, P.W.D., Lahore.

(*Secretary*).

F.—GEOLOGY, GEOGRAPHY AND ANTHROPOLOGY

Dr. O. Schmieder, Professor of Geography, Karachi University, Karachi, (*President*).

Dr. Nafees Ahmad, Chairman, Department of Geography, Dacca University.

Dr. H. Crookshank, Director, Geological Survey of Pakistan, Quetta.

Dr. K. S. Ahmad, Chairman, Department of Geography, Panjab University.

Professor O. A. Broch, Head, Department of Mineralogy, Panjab University.

Mr. Asrarullah, Department of Geology, Panjab University, Lahore.

Mr. Mohammad Ashraf Khan Durrani, Deptt. of Geography, Peshawar University.

Mr. S. Z. Ahsan, Department of Geography, Karachi University.

Dr. (Miss) Mariam Karam Ilahi, Department of Geography, Panjab University.

Dr. Shamsul Islam Siddiqi, Department of Geography, Karachi University.

Mr. Khalilullah Qureshi, Department of Geography, Panjab University, Lahore.

Mr. M. I. Ahmad, Senior Geologist, Geological Survey of Pakistan, Quetta.

Mr. A. M. Patel, Department of Geography, Dacca University, Dacca.

Mr. M. Zahir-ul-Haque, H.R.H. the Agha Khan Scholar, England.

Mr. S. M. Hasan, H.R.H. the Agha Khan Scholar, University of Sydney, Australia.

Dr. S. M. Shuaib, Deptt. of Geology and Mineralogy, Pb. University, Lahore,

(*Secretary*).

G.—MEDICINE : VETERINARY SCIENCES

- Dr. S. M. Sarwar, Principal, Punjab College of Animal Husbandry, Lahore, (*President*).
 K.B. Dr. M. S. Mahmood, Chief Medical Officer, N.W.R., Lahore.
 Dr. G.M.K. Baloch, Professor of Medicine, F. J. Medical College for Women, Lahore.
 Dr. M. A. Pirzada, K. E. Medical College, Lahore.
 K. B. Dr. Mohammad Yusuf, 5, Durand Road, Lahore.
 Dr. Abdul Hameed, D.M.O., N.W.R., Karachi.
 Dr. M. Abdussalam, Punjab Veterinary College, Lahore,
 Dr. A. Wahid, Professor of Medicine, Medical College, Dacca.
 Dr. Mushtaq Hasan, Dow Medical College, Karachi.
 Dr. Bilqees Fatima, Professor of Gynaecology, F. J. Medical College, Lahore.
 Col. Dr. F. M. Khan, Director of Health Services, Punjab, Lahore.
 Dr. S. M. A. Shah, Director of Animal Husbandry, Punjab, Lahore.
 Dr. Aziz Ahmad, D.P.H., Baghbanpura, Lahore.
 Dr. K. S. Shah, Dean, Institute of Hygiene and Preventive Medicine, Lahore.
 Dr. S. M. K. Wasti, K. E. Medical College, Lahore. (*Secretary*).

H.—PHYSICS : MATHEMATICS : STATISTICS : ASTRONOMY AND METEOROLOGY

- Dr. S. M. Mitra, Professor of Physics, Dacca University, Dacca, (*President*).
 Professor Abdus Salam, Head, Department of Mathematics, Panjab University.
 Dr. M. Zia-ud-Din, Director, Institute of Statistics, Panjab University, Lahore.
 Dr. M. Razi-ud-Din Siddiqi, Vice Chancellor, Peshawar University.
 Dr. Abdul Haque, Professor of Physics, Rajshahi University, Rajshahi.
 Dr. Nazir Ahmad, Chairman, Pakistan Tariff Commission, Karachi.
 Mr. A. R. Nasir, Assistant Professor of Mathematics, Engineering College Lahore.
 Dr. A. M. Chaudhury, Reader in Physics, Dacca University.
 Dr. A. B. Pal, Department of Physics, Panjab University, Lahore.
 Mr. S. N. Naqvi, Director, Meteorological Department, Karachi.
 Prof. A. L. Shaikh, Principal, D. J. Sind Government Science College, Karachi.
 Dr. W. A. Jenkins, Vice-Chancellor, Dacca University, Dacca.
 Dr. D. M. Qureshi, Statistician, Agricultural College, Lyallpur.
 Dr. S. M. A. Haque, Reader in Mathematics, Dacca University, Dacca.
 Dr. Syed Mujtaba Karim, Head, Department of Physics, Karachi University,
 (*Secretary*).

RECEPTION COMMITTEE

Chairman :

Alimartabat A. R. Khan, C.S.P., Mushir-i-Ala, Bahawalpur.

Secretary :

Mr. Baqa Mohammad Khan, Director of Public Instruction, Bahawalpur.

Members :

All Secretaries to the Government and all Heads of the Departments,
Bahawalpur Government.

LOCAL ORGANISING COMMITTEE

President :

Mr. Z. H. Burney, Chief Secretary, Government of Bahawalpur.

Secretary :

Mr. Baqa Mohammad Khan, Director of Public Instruction.

Members :

Syed Hasnain Ahmad, Chief Engineer.

Mr. Ehsan-ul-Huq, Financial Commissioner.

Col. K. M. Sana, Director of Health Services.

Lt.-Col. Irshad Ahmad Khan.

Lt.-Col. S. M. Hassan.

Dr. S. Jamalullah, Director of Agriculture.

Sh. Fazal Karim, Director of Information and Public Relations.

Hafiz Abdul Haq, Principal, S. E. College.

Mr. Enver Sikander Khan, Principal, Sadiq Public School.

M. Iqbal Siddiqui, Professor of Physics, S. E. College.

SUB-COMMITTEES

A.—ACCOMMODATION, TRANSPORT AND ENTERTAINMENT COMMITTEE.

Chairman :

Mr. Z. H. Burney, Chief Secretary, Bahawalpur Government.

Vice-Chairman :

Mr. Ehsan-ul-Haque, Bar-at-Law, Financial Commissioner, Bahawalpur
Sardar Mophammad Rahim Khan Leghari, Inspector-General of Police.

Secretary :

Mr. Abdul Haq, M.A., Principal, S. E. College, Bahawalpur.

Members :

Mr. M. A. Subzwari, Finance Secretary, Bahawalpur Government.
Maulvi Akhter Ali, D.C., Bahawalpur District.
Agha Mohammad Ajmal, Ex. En., B. & R. Division, Bahawalpur.
Mr. S. Z. Haq, Executive Engineer, E. & M. Division, Bahawalpur.
Mr. Nazir Ahmad, Superintendent, Toshakhana, Bahawalpur.
Miss G. A. Ghani, Principal, Girls College, Bahawalpur.
Lt. Samuel Bedi, Secretary Scouts.

B.—FINANCE COMMITTEE.

Chairman :

Sardar Mohammad Aslam, Accountant-General, Bahawalpur Government.

Secretary :

Syed Din Mohammad Shah, A.A.G., Bahawalpur.

Members :

A. Hasan Esquire, Deputy Chief Engineer, Bahawalpur Government.
Maulvi Akhtar Ali, Deputy Commissioner, Bahawalpur District.
Rao Fazl-ur-Rehman Khan, D.C., Rahimyar Khan District.
Sh. Mohammad Hussain, D.C., Bahawalnagar District.
Malik Bashir Ahmad, A.I.G. Police, Bahawalpur Government.
Mirza Najib-Ullah, A.A.G., Bahawalpur.
Mr. Mohammad Envar, Headmaster, Bahawalpur.

C.—EXHIBITION COMMITTEE.

Chairman :

Khan Bahadur Alam Ali Khan, Director of Prisons, Bahawalpur.

Secretary :

Professor Abdul Majid, Bursar, Sadiq Public School, Bahawalpur.

Members :

Professor Mohammad Iqbal Siddiqui.

Mr. Mohammad Shabbir Bokhari, Officer on Special Duty, Bahawalpur.

Malik Nazir Ahmad, State Librarian, Bahawalpur.

Mr. Abdul Majid, M.A., Principal, Technical High School, Bahawalpur.

Miss Z. M. Shah, Deputy Inspectress of Schools, Bahawalpur.

D.—PUBLICITY COMMITTEE.*Chairman :*

Mr. Fazal Karim.

Secretary :

Mr. Fazal-i-Hamid.

Members :

Dr. Karim-Ullah.

Professor Habib-Ullah.

Mr. Mohammad Shabbir Ansari.

E.—EXCURSION COMMITTEE.*Chairman :*

Mr. A. Hasan, Deputy Chief Engineer, Bahawalpur.

Secretary :

Shah Fazal Karim.

Members :

Mr. Abdul Majid.

Malik Bashir Ahmad.

PROGRAMME

- Friday, Jan. 21, 1955 **Inauguration of the Conference.**
- 10 a.m. Recitation from the Holy Quran
Opening speech by the retiring General President.
Address of Welcome by the Chairman, Reception Committee
Inauguration of the Conference by the Ameer of Bahawalpur.
Presidential Address by the General President.
Annual Report of the P.A.A.S. by the General Secretary.
Introduction of the Foreign Delegates and
Messages of Goodwill.
- Afternoon Session**
- 3-30 p.m. Opening Ceremony of the Atoms for Peace Exhibition.
Introductory Speech by the U. S. A. Ambassador to Pakistan.
Opening of the Exhibition by the Ameer of Bahawalpur.
- 4-30 p.m. Reception in honour of Overseas Scientists and Delegates to the Conference by the Reception Committee.
- 6 p.m. Symposium on ' PROBLEMS OF ARID ZONES with Special Reference to Bahawalpur.'
- Saturday, Jan. 22, 1955 Reading of Papers and Symposia in all Sections.
- 8-30 a.m.
- 9-30 a.m. Presidential Address :—Education Section.
- 10-30 a.m. Presidential Address :—Agriculture Section.
- 11-00 a.m. Presidential Address :—Biology Section.
- 11-30 a.m. Presidential Address :—Physics Section.

Afternoon Session

- 2-30 p.m. Symposium on ANTIBIOTICS IN MEDICAL AND VETERINARY PRACTICE.
- 3-30 p.m. Reading of Papers in all Sections.
- 6-00 p.m. Popular Lecture.

Sunday, Jan. 23, 1955.

- 8-30 a.m. Reading of Papers and Symposia in all Sections.
- 9-30 a.m. Presidential Address :—Engineering Section.
- 10-00 a.m. Presidential Address :—Chemistry Section.
- 10-45 a.m. Presidential Address :—Geology, Geography Section.
- 11-30 a.m. Presidential Address :—Medicine Section.

Afternoon Session

- 2-30 p.m. Popular colloquium on PEACEFUL USE OF ATOMIC ENERGY.
- 6-00 p.m. Popular Lecture by Prof. Dudley Stamp on 'Land and People.'

Monday, Jan. 24, 1955. Reading of Papers and Symposia in all sections.

- 10-00 a.m. Symposium on PROBLEMS OF FOOD PRODUCTION IN PAKISTAN.

Afternoon Session. Reading of Papers and Sectional Symposia in all Sections.

- 2-30 p.m. Lecture by Dr. Nazir Ahmad on 'Science and Utilization of National Resources.'
- 6-00 p.m. Popular Lecture

Tuesday, Jan. 25, 1955.

- 9-30 a.m. Business Meetings in all Sections.
- 10-30 a.m. Popular Lecture by Professor W. H. Pearsall on 'Production Biology.'

Afternoon Session.

- 2-30 p.m. Annual General Meeting of the Pakistan Association for the Advancement of Science.
- 7-30 p.m. Farewell Banquet by the Bahawalpur Government.

Wednesday, Jan. 26, 1955. All day excursions to Panjnad, Derawar, etc.

LIST OF DELEGATES

U. K.

Prof. W. H. Pearsall, F.R.S., Professor of Botany, University College, London.
Prof. Alfred Maurice Binnie, Hydraulics Department, University of Cambridge.
Prof. Sir L. Dudley Stamp, London School of Economics.
Mr. H. R. Mills, Scientific Adviser to U. K. Govt. in South East Asia, Colombo.

Egypt

Prof. Dr. Abd-el-Halim Montasir, Dean, Faculty of Science, Abbasia, Cairo.

Germany

Prof. Dr. Alwin Walther, Institute of Practical Mathematics, Darmstadt.
Prof. Dr. Bartz, Bonn University.

India

Dr. D. S. Kothari, Professor of Physics, University of Delhi.
Dr. P. Maheshwari, Professor of Botany, University of Delhi.

Japan

Dr. Juichiro Nakahara, Member, Science Council of Japan, Tokyo.

U.S.A.

Dr. W. Robbins, National Academy of Sciences, U.S.A.

Indonesia

Prof. Dr. Sardjito, President, State University *Gadjah Mada*, Jogjakarta.

U.S.S.R.

Professor Afanassiev, Professor of Geology, U.S.S.R.

People's Republic of China

Prof. Chien Tuan-Sheng.	Mr. Hsich Yu.
Mr. Chou Man.	Mr. Ting Ku.

Canada

Mr. Richard W. Plummer.

Overseas Scientists in Pakistan.

Dr. Shipley McIntosh.	Dr. A. E. Palmer.
Dr. R. E. Watts.	Mr. John V. Vaughan.
Mr. John Hutzel.	H. E. Mr. Horace A. Hildreth.
Mr. R. John Wilson.	Mr. Allen H. Conneje.

Dr. O. Shaw.	Dr. B. H. Schneider.
Mr. Marshal Berg.	Mr. Robert E. Tally.
Mr. Clyde Eddy.	Mr. Roberts Burns.
Mr. John Thomson.	Mr. F. J. Wakelin.
Mr. Geoffrey Ashall Glaister.	Mr. R. F. T. Farrant.

*East Bengal**Rajshahi University :*

Dr. M. N. Alam, Department of Physics.
 Dr. Md. Kiamuddin, Department of Chemistry.

Dacca University :

Dr. S. M. A. Haque.	Dr. Majeed Ahmad, Reader in Botany.
Dr. M. Ahmad, Reader in Chemistry.	Dr. Badiuzzaman, Lecturer in Botany.
Dr. S.K. Yusufzai, Head, Deptt. of Zoology.	Dr. A.Q. Bazlul Karim.
Mr. A. M. Patel, Deptt. of Geography.	Dr. A.M. Chaudhury, Reader in Physics.
Dr. A. Latif, " "	Dr. K. Ahmad, Deptt. of Biochemistry.
Mr. K.A. Hasan, Deptt. of Soil Sciences.	

Jute Research Institute, Dacca :

Dr. S. D. Chaudhuri, Director.

Comilla :

Mr. M. M. Haq, Officer-in-Charge, Pakistan Animal Husbandry Research Institute.

Karachi

Dr. Nazir Ahmad, Chairman, Pakistan Tariff Commission,	Karachi.
Sheikh Naseer Ahmad, Director, Pakistan Industrial Development Corp.,	"
Dr. Taskhir Ahmad, Director, Department of Plant Protection,	"
Dr. Abdul Hafiz, Department of Plant Protection,	"
Mr. S. M. Ali; Education Officer, Government of Pakistan,	"
Dr. A. Kamal, Senior Research Officer, P. C. S. I. R.,	"
Dr. G. Hahn, Council of Scientific and Industrial Research,	"
Mr. S. A. Malik, P. C. S. I. R. Laboratories,	"
Dr. S. Mehdi Hassan, Head, Division of Biochemistry, P. C. S. I. R.,	"
Mr. Jamal Qadir, Research Chemist, P. C. S. I. R.,	"
Mr. S. Q. Hasan, " " "	"
Mr. A. N. K. Zaki, P. C. S. I. R., Laboratories,	"
Mr. T. M. Oag, Director, (Navigation), Central Engg. Authority,	"
Mr. S.I.H. Rizvi, Deputy Director, (Elec.), Central Engg., Authority,	"
Dr. F. A. Hamdani, Assistant Director, (Elec.), " "	"
Dr. O. Schiemeder, Head, Department of Geography, Karachi University,	"

Prof. Q. M. Aslam.	Karachi University, Karachi.
Mr. S. Zahir Ahsan,	„ „ „
Dr. M. A. H. Qadri.	„ „ „
Dr. S. M. Karim, Head, Department of Physics,	„ „ „
Dr. B. B. Qureshi, Central Government College for Women,	„
Dr. G. M. D. Sufi, Nariman Road, New Town,	„

Sind

Ch. Bashir Ahmad Bhatti, Bodar Farm, Sind.

Baluchistan

Dr. O. R. Khan, Economic Botanist in Baluchistan, Quetta.
 Dr. Asrarullah, Senior Geologist, Geological Survey of Pakistan, Quetta.
 Major R. A. Qureshi, Quetta.

Punjab

Dr. Bashir Ahmad, Director, West Regional Laboratories, P.C.S.I.R., Lahore.	
Prof. M. Afzal Hussain, Vice Chancellor, Panjab University,	„
Dr. Kazi S. Ahmad, Chairman, Department of Geography, Panjab University,	„
Dr. S. M. Shuaib, Department of Geology,	„ „ „
Dr. M. Zia-ud-Din, Director, Institute of Statistics, Panjab University,	„
Dr. Badar-ud-Din, Director, University Institute of Chemistry,	„ „
Dr. M. I. D. Chughtai,	„ „ „ „
Mr. Riaz-ur-Rahman,	„ „ „ „
Mr. Aejaz Hussain,	„ „ „ „
Mr. Qamar Din Ansari,	„ „ „ „
Mr. A. D. Ashraf, Chief Engineer, Irrigation, P.W.D., Punjab,	„
Dr. Mir Mushtaq Ahmad, Director, Irrigation Research,	„
Mr. Mohiuddin Khan, Director, Central Designs, Irrigation Branch,	„
Dr. Nazir Ahmad, Physicist, Irrigation Research Institute,	„
Dr. Niaz Ahmad, Deputy Director (Central Designs), Irrigation Research	„
Mr. Abdul Latif, Irrigation Research,	„
Mr. Munawar Hussain, Assistant Research Officer,	„
Mr. A. K. Bhatti, Assistant Research Officer,	„
Dr. A. G. Asghar, Director, Land Reclamation,	„
Dr. S. M. Sarwar, Principal, Govt. College of Animal Husbandry,	„
Dr. M. Abdussalam,	„ „ „ „
Dr. M. Maqsood,	„ „ „ „
Mr. A. S. Akhtar,	„ „ „ „
Mr. M. Sarwar,	„ „ „ „
Mr. Akram Bhatti,	„ „ „ „
Mr. Q. Khan,	„ „ „ „

Mr. Nazir Sadiq,	Govt. College of Animal Husbandry, Lahore.
Dr. Qureshi,	" " "
Mr. Mohammad Ashiq Hussain.	" " "
Dr. M. A. Azeem, Government College,	"
Dr. Ahsan-ul-Aslam,	" "
Professor M. M. Sharif, Principal, Islamia College,	"
Dr. S. M. K. Wasti, Mayo Hospital,	"
Mr. M. I. Khan, Conservator of Forests, Punjab,	"
Dr. Atiqur Rahman Ansari,	"
Dr. M. A. Hamid, Army Medical Store,	Lahore Cantt.
Lt. Comdr. A. Latif, Agricultural College,	Lyallpur.
Mian Allah Bakhsh, Pir Mahal,	"
Abdul Wahid Khan, Pest Control Officer, T.D.A.,	Jauharabad.

N.W.F.P.

Dr. M. R. Siddiqui, Vice-Chancellor, Peshawar University,	Peshawar.
Dr. M. S. H. Siddiqui, Principal, Engineering College,	"
Major Aftab Ahmad, Boys Battalion, R.P.E.C.,	Risalpur.
Dr. M. Afaf, G. H. Q. Science Laboratory,	Chaklala.
Dr. M. T. Chaudhury,	" " "
Mr. M. H. Khan,	" " "
Major N. Iqbal,	" " "

STUDENT DELEGATES

Mohammad Aqil.	Zulfikar Ali.	Rafiq Ahmad Saqib.
Amanullah Khan.	Syed Farrukh Hussain Shah.	M. Saleem Habib.
M. Irfanullah.	Mohammad Siddique.	M. Aslam Awan.
Mubarak Ahmad.	A. Salam Sheikh.	M. Mahmood Hussain.
Yaqoob Malik.	Mohammad Sayeed.	M. Ahsanullah,
M. Yasin Qureshi.	Abdul Qaseem.	Bashir Khan Arif.
M. Sayeed Khan.	Waheed-ud-Din.	M. A. Khan.
Mohammad Shafi.	Mohammad Shafiq.	Afzal Elahi.
Ahmad Saleem.	M. Ishaque Akhtar.	Abdul Waheed Khan.

OPENING PROCEEDINGS

ADDRESS OF WELCOME

BY

ALIMARTABAT MR. A. R. KHAN, C. S. P., MUSHIR-I-ALA, BAHAWALPUR,
Chairman of the Reception Committee.

YOUR HIGHNESS, MR. PRESIDENT, LADIES AND GENTLEMEN,

It is a great privilege and pleasure for me as Chairman of the Reception Committee of the Pakistan Science Conference to thank you most sincerely on my behalf and on behalf of the Reception Committee for your presence here and to extend to the members and the delegates a warm and hearty welcome. We are particularly grateful to the eminent and leading scientists from abroad, who have travelled a long way, at considerable personal inconvenience, to participate in our deliberations and help us solve our problems. In tackling the tasks that lie ahead their assistance and advice will be most valuable. The fact that distinguished scientists from the Eastern and Western hemispheres are present here to-day in a spirit of fellowship and mutual helpfulness is an index to the true spirit of Science, which is service of humanity irrespective of the barriers of colour, creed, race and region. As a layman I cannot venture to speak with any semblance of authority on the philosophy of scientific knowledge and endeavor. Yet I can say without fear of contradiction that all the great men of Science—discoverers, inventors, explorers—have been prompted by the love of knowledge and the desire to be useful and that they have acted from motives of the highest type of altruism. It is however a sad commentary on the imperfections of human nature that aggressive nationalism or the genocidal urge for destruction has sometimes exploited the patriotic sense of scientists and they have willy-nilly allowed their scientific knowledge and skill to be used for inventing terrible weapons of destruction and total annihilation. In spite of this exploitation of scientific talent and misuse of scientific discovery, there is nothing fundamentally wrong with the scientific spirit of the present age. Science continues as before to work for the alleviation of human suffering, for the furtherance of human happiness and the increase of human comfort. The scientists of the present-day are conscious of the truth that material sciences must go hand in hand with the social sciences. In other words science applied to external objects—objects external to man—should

not be divorced from the larger context of human happiness. Scientists of world-wide fame and of the greatest intellectual pre-eminence are fully conscious of the colossal dangers to the very existence of the human species from such weapons of mass destruction as the Atom Bomb and the Hydrogen Bomb. They are showing an increasing awareness of the fact that unless we can harness Atomic Energy to the creative needs and constructive purposes of mankind the destruction of civilization as known to us is certain. They are, therefore, directing Atomic Energy towards the field of industry and economic production. Fortunately for the future of humanity, America, which is in the vanguard of scientific research and inquiry, leads the way to peace by promoting the interests of economic sufficiency. With the blessings of the U.N.O., America is doing a great deal for the development of economically backward and under-developed areas of the world. Its distinguished scientists are engaged on the task of building up and utilizing Atomic Energy for industrial and agricultural purposes.

LADIES AND GENTLEMEN,

I am sure you would like me to convey our thanks to the Government of the United States of America for sending here the Atomic Energy Exhibit, which is being displayed by the U.S. Information Section at the Conference to illustrate the peaceful use of this vast source of Energy. This utilitarian attitude which is a happy augury for the future is the outcome of two considerations: First, that the world is one and there cannot be islands of happiness, peace and plenty in a miserable world suffering from scarcity and want; secondly, that the causes of war are largely economic. If production is stepped up, standards of living of the common man are raised to a reasonable extent and the fear of starvation and want is removed from all countries. Wars of aggression as well as ideological conflicts that led to class strife and international conflagrations will become things of the past.

LADIES AND GENTLEMEN,

It is gratifying to note that the Pakistan Science Conference which has been held annually for the last six years has given a great impetus to scientific and technological investigation in this country and awakened a keen interest among the people in scientific pursuits. The economy of Pakistan is mainly agricultural but agriculture cannot thrive or yield its best results without the aid of scientific methods. In the present period of human history when owing to the decreasing death rate, production is finding it increasingly difficult to keep pace with the demands of a growing population, the need of applied science in the sphere of agricultural development cannot be over-emphasised. It is also obvious that no country can prosper in a purely agricultural system of national economy. Industrial expansion and agricultural development must be

mutually adjusted in a harmonious structure and correlated to the expanding needs of a dynamic social order. Technological laboratories and institutes for scientific and industrial research have therefore to play a great role in the future development of Pakistan. For many years in this land, scholastic education comprising literature and the social sciences held sway and the study of material sciences was assigned a place of secondary importance. But after the dawn of freedom, education has received a scientific and technical bias and emphasis has shifted to material sciences not merely as a means of man's mastery over the universe of Matter or Nature but also in the large interest of his mastery over 'self,' in other words, as a means of his intellectual and physical development covering the whole range of his behaviour as a rational moral creature. We are indebted to the Pakistan Association for the Advancement of Science for its invaluable services to the cause of science in this country. It has organized under its auspices Science Conferences and such other activities as are conducive to the growth of the spirit of scientific research and inquiry. The Association may look forward with confidence to greater achievements in the brighter years to come.

LADIES AND GENTLEMEN,

His Highness the Ameer of Bahawalpur who is a descendant of the great Abbasid Caliph of Baghdad, famous in the gilt-edged pages of history for their magnificent patronage of philosophy, arts and sciences, has done us a singular honour by acceding to our request very kindly to come here and inaugurate this Conference. I now request your Highness to declare the Conference open.

INAUGRAL ADDRESS

BY

LT. GENL. H.H. AL-HAJ DR. SIR SADIQ MOHAMMAD KHAN ABBASI V, LL.D.,
Ameer of Bahawalpur.

I am grateful to the Pakistan Association for the Advancement of Science for extending to me the courtesy of inviting me to inaugurate this the Seventh Annual Pakistan Science Conference to-day.

I am quite sure that all of us here in Bahawalpur are delighted that the State's capital Baghdad-ul-Jadid has been chosen as the venue of this Conference. What a happy coincidence to find that such a Conference should be held not far from a place which once enjoyed great renown as being the seat of great learning at a time so far back as the 4th century Al-Hijri when Hazrat Safi-ud-Din Gazruni, the great scholar from Baghdad established an Institution of learning at Uch, which we in these times would describe as a University. The famous author of the "TABAQAT-I-NASRI", Minhaj-us-Siraj, was one of its brilliant Professors.

It would also not be out of place to mention that the illustrious dynasty of the Abbasids from whom I have the privilege of claiming descent were renowned for their patronage of learning and the Arts and it is indeed a historical fact that the Arabs certainly left a very great legacy to mankind by making such great strides in the different spheres of scientific activities such as surgery, medicine and many other branches of scientific research and inventions, all for the betterment and welfare of God's people.

It is indeed something to be proud of, that this little corner of our beloved motherland, Pakistan, should have been selected for the meeting place of such a distinguished gathering, and may I on behalf of all of us here, offer a most hearty and warm welcome to you all, especially to those who have, I am sure, at great personal inconvenience travelled from far off lands. This very fact is in itself a proof, if proof be needed, of how united are all those who are eager to make man's life happier, healthier, and well-contented through the power of knowledge that God has bestowed upon them. Being thus well-equipped they are able to concentrate on matters of construction, so that the world may be a better place to live in.

In fact all these efforts could be considered as a crusade in the service of humanity in ever endeavouring to bring about peace, progress and prosperity, a cause most laudable and well deserving every praise.

Nevertheless there are always the chances of Science being directed to to matters destructive. Let us hope that these may not be too many. For have we not one horrid example in the shape of Atomic Forces of destruction? On the other hand the fact can hardly be denied that an army well-provided with modern scientific equipment would have a strong influence in maintaining peace and order, where and when such a necessity should arise.

I have no desire to dwell at length on problems far beyond my humble understanding, as I am sure all gathered here must be only too eager to get down to business and not listen to a long and uninteresting speech.

But in conclusion I would make a reference to the fact that Pakistan being such a young country which may even be considered as one of the under-developed parts of the world stands in much need of every possible assistance. May I express the hope that our scientists will receive all possible encouragement enabling them to be better equipped to alleviate the lot of the common man as well as bring about improvements that are badly needed in our agricultural and industrial methods and the developments of untapped mineral resources. In all matters, scientific guidance and advice would be invaluable. We are all confident that an organisation such as yours, under the auspices of international good-will, will see us through all these difficulties.

I would therefore reiterate that it is indeed a great privilege and pleasure to welcome here so many eminent scholars in the world of science.

I sincerely hope that the Conference will be a great success and I do hereby take much pleasure in declaring it open.

INTRODUCTORY SPEECH

BY

DR. M. R. SIDDIQUI, VICE-CHANCELLOR, PESHAWAR UNIVERSITY,
Retiring President of the P.A.A.S.

Another year has gone by since we met last at Karachi. We are meeting this time in this historic city which bids fair to become the equal of the old Capital of the Abbasi Caliphs which has been immortalised by the Story-tellers of the 'one thousand and one nights.' This is indeed a unique occasion in the history of our Association, because we are meeting for the first time in a State. We are really extremely grateful to Ala Hazrat the Ameer of Bahawalpur, who extended his kind patronage to the Association and has graced the occasion by performing the inauguration of the Conference. We are also greatly indebted to the Administrators of the State who are kind enough to come to our rescue and invited us to hold the Conference here, even though there were only a few weeks left. It is difficult for me to thank them adequately for the hospitality they have offered and the arrangements they have made at such short notice. I hope the members of the Local Organising Committee and all those who have worked untiringly for the organisation and the arrangements of the Conference would accept the sincere thanks which I offer to them on behalf of all the members of the Association.

At our last meeting I had the privilege of placing before you some of the reasons why we had not made as much headway in scientific development and research as we should have done. I had also recounted a few measures that were necessary for remedying this state of affairs. I was indeed grateful to note that my observations were received with keen interest not only by my colleagues in the scientific professions, but also by other people occupying responsible position in the administration of the country and in the general life of the community. It is heartening to find that our people are generally alive to the importance of science, and are sincerely desirous of doing the right

thing for its promotion. I have been repeatedly informed that if only the political and economic problems were not so pressing, and if the authorities had a little breathing time, everything would be done for the development of education in general and science in particular. While it is gratifying to know that the importance of scientific education and research is realised, one could perhaps wish that its urgency were also recognised with equal force. I am afraid our people have perhaps not yet fully realised that it is only the proper development in education and science which can show the way to the solution of those very problems on which our whole attention is at present concentrated. I have no doubt that this realisation will also come about soon, and that we shall then be on our way to progress and prosperity.

To be quite fair to everyone concerned, I have got to present the other side of the picture and to record the improvement that has taken place in the situation. The supreme organisation of top-ranking scientists, *viz.*, the Pakistan Academy of Sciences has been recognised by the Central as well as Provincial Governments and has been given grants-in-aid. Government have also agreed to give it a Charter. The Council of Scientific and Industrial Research has been vigorously active during the last year, and has been assured of substantial funds for its development. A welcome feature of the organisation of the Council is the improvement in scale of salaries offered to its scientific and technical personnel. As I pointed out in my address last year, the scientists and educationists in the country are very much neglected, and need all the encouragement and recognition that could be given. The Council has recognised the necessity of this re-adjustment, and is offering better prospects to its workers than those offered to scientists in the past. Let us hope that the educational institutions and the Universities will not lag behind and give due recognition to their highly trained and qualified staff.

The establishment of an Institute of Research on Atomic Energy has been very much in the public eye during the last few weeks. Government have accepted the principle, and have appointed a Committee to plan the details. This is a measure of their earnestness to do whatever they can for the advancement of science. I have heard occasional remarks to the effect that the founding of such an Institute would be a sheer waste of time and money, as we cannot hope to compete with the big powers in this matter. Apart from the fact that this is a counsel of despair, and indicates a defeatist mentality, it should not be forgotten that we have no intention or desire of manufacturing the atomic bomb but wish to confine ourselves solely to the experiments on the develop-

ment of atomic energy for peaceful purposes. I do admit that even we must undertake this and such other projects in order to keep our self-respect, if for no other reason. We cannot and should not remain a parasite on others, and must contribute our share to the general progress of mankind through advancement of knowledge. The decision of Government therefore, is most welcome, and we hope that all sections of the people would help to their utmost in the completion of these schemes as early as possible.

It is the essence of democracy that all citizens should share the responsibility of organisation and development just as they wish to enjoy the blessings of civilization. The well-to-do people have a special obligation in this respect. They owe a moral as well as social debt to the community which has given them the right atmosphere and the necessary chance of amassing their wealth and preserving it. But for the protection offered by an organised society they could not have done so, and the least they can do for the society in return is to refund to it a part of their gains so that the community may use it for its development and progress. This will result ultimately in the enrichment and prosperity of the donors themselves. The endowment for the purpose of development of science and education is thus nothing but enlightened self-interest.

I wish to set up a new tradition and say a few words about the General President, who is assuming office this morning, and in whose hands the destinies of the Association will remain during the next year. Dr. Salimuzzaman Siddiqui has been engaged in advanced studies and research for more than thirty years. After completing his studies in Germany, he worked for some time in the Calcutta Laboratories, but was soon selected by the late Hakim Ajmal Khan to work on indigenous drugs in the Tibbia College, Delhi. His work on the alkaloids and other products secured out of ordinary Neem and Bhilavan are too well known to require detailed description. When the Council of Scientific and Industrial Research was established by the Government of India in 1940, he was the obvious choice for the Directorship of the Chemical Laboratories. At one stage he was selected for the National Chemical Laboratories at Poona. His many researches made and numerous patents obtained while working in the Council Laboratories at Delhi earned for him a reputation as one of the foremost chemists of the continent. All who were present at the Karachi Conference last year would no doubt remember the glowing tribute paid to him by the late Dr. Bhatnagar.

He was called upon by the Government of Pakistan in 1947 to organise the Council of Scientific and Industrial Research in this country. We have all seen with what vision and foresight he has planned the whole work and with what energy he has executed these plans, while at the same time carrying on research of great economic and industrial importance on coal and resins. His leadership of this Association is, therefore, a happy augury for the advancement of science as well as for the betterment of the conditions of scientific workers in the country.

With these remarks, Mr. President, I have the utmost pleasure in handing over the charge of General Presidentship to you and have no doubt that during your tenure of office the Association will make considerable progress towards the achievement of the objects for which it has been established.

MESSAGES OF GOODWILL

His Excellency Mian Mushtaq Ahmad Gurmani,
Governor of the Punjab.

I offer my sincere greetings to the Seventh Pakistan Science Conference which is being held in the hospitable city of Bahawalpur. To me, Science is something much more than mere inventions; it transcends all its applied marvels. One of the best hopes for the future welfare of humanity is the beginning of unbiased investigation of social, moral, material and psychological facts. If the disintetested pursuit of knowledge were to cease the structure of society would cease to grow. Between the middle of the eighth and the early part of the twelfth century, Muslims held the intellectual supremacy throughout the civilized world. It is for your Association now to revive this great tradition. The Principle of understanding and reflection is essential in our religion. Revelation itself is made to those who can understand; the holy Quran says, "We make clear the communications for a people who reflect; most surely in the creation of the heavens and the earth and the alternation of the night and the day there are signs for men of understanding—Say: Are those who know and those who do not know, alike? Only the men of understanding are mindful." It is tragically true of course that scientific inventions have placed enormous means and power at the disposal of scientifically advanced nations who, taking advantage of the deficiencies of others, are tempted to use the scientific knowledge to dominate the weak. Shallow and thoughtless critics blame science for the invention of new and dangerous weapons of destruction. In fact, it is not science but lack of spiritual values which has caused this unbalance. We have to learn to harness the scientific mind in the service of the merciful heart. At the root of all civilization is a spiritual urge, an insatiability in man which demands something more than self-preservation or happiness or security. If this is denied its proper course, then it takes the form of just wanting more and more things to escape the feeling of purposelessness. Those who pin all their hopes on a machine-made paradise, will find it a prison, supposing they get there. There is no real conflict between the humanistic and scientific approach. We in Pakistan need scientists and humanists

to come together to consider in detail what kind of enrichments of the human personality modern technique could make possible; and then we must decide what kind of social organisation will assist in bringing them about. Let us pursue science in the true Islamic spirit of human brotherhood and peace and freedom for mankind.

I wish your deliberations all success.

Prof. W. H. Pearsall, F.R.S., and Prof. A. M. Binnie,
Delegates of the British Association for the Advancement of Science.

The President and the Council of the British Association for the Advancement of Science, wished us to convey to the Pakistan Association for the Advancement of Science all good wishes for the success of the meetings at Bahawalpur, greetings to brother scientists in Pakistan and congratulations on the successful efforts being made to develop scientific services and natural resources in Pakistan.